

11th INTERNATIONAL CONGRESS ON CONTEMPORARY SCIENTIFIC RESEARCH

March 12-15, 2025 Ho Chi Minh, Vietnam

(THE PROCEEDINGS BOOK)

EDITORS

Assoc. Prof. Dr. Ayhan AKSAKALLI Aslıhan ADA

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HEAD OF SESSION: Ethem ILHAN ŞAHİN			
AUTHORS	AFFILIATION	TOPIC TITLE	
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Ayhan BiLiR	İstanbul Atlas University	LITHIUM CHLORIDE INDUCES MITOPHAGY AND INCREASES INTRACELLULAR INTERMEDIATE FILAMENTS IN 3D ISHIKAWA SPHEROID CULTURES	
Sedat CERECI	Hatay Mustafa Kemal University	ARTIFICIAL INTELLIGENCE VERSUS NATURAL INTELLIGENCE	

	ONLINE PRESENTATIONS			<u>a</u>	
	ZOOM	13.03.2025 / S	essic	on-1, Hall-1	لقات
	HO CHI MINH	LOCAL TIME	C	ANKARA LOCAL	TIME
Ø	14 ⁰⁰ : 16 ⁰⁰		Ø	10 00 : 12 00	

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Thuy Vo Thi Thu	Nguyen Tat Thanh University	TRAINING IN APPLIED ART DESIGN WITH A FOCUS ON SUTAINABLE DEVELOPMENT
Nguyễn Thị Bích Vân	University of Architecture Hochiminh	BIODEGRADABLE AND RECYCLABLE BUILDING MATERIALS: POTENTIAL AND CHALLENGES IN ARCHITECTURE INTERIOR DESIGN
Ngan Ha Ngo	Nguyen Tat Thanh University	THE ROLE OF VISUAL ARTS IN HUE'S ROYAL ARCHITECTURE
Nguyen Thi Bich Van Nguyễn Thị Hồng Phúc	University of Architecture Hochiminh	INTEGRATION OF AI IN BATHROOM DESIGN: TOWARDS CONVENIENCE AND UNIVERSAL DESIGN
Neriman Gül ÇELEBİ Ümit ARPACIOĞLU	Mimar Sinan Fine Arts University	LIFE CYCLE ASSESSMENTS (LCA) AND LIFE CYCLE COSTING (LCC) OF STRUCTURAL SYSTEMS
Lam Le Thanh	University of Architecture Ho Chi Minh City	BIOPHILIC TRENDS IN OFFICE INTERIOR DESIGN IN HO CHI MINH CITY
BENAISSA Nadjette Belkacemi Hadjer	University of Biskra	THE CHALLENGE OF SLUMS AND INFRASTRUCTURE PROVISION: THE CASE OF SIDI GHAZAL NEIGHBORHOOD IN BISKRA



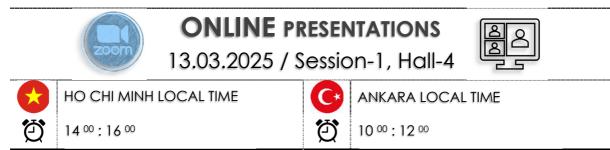
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İsmail CANER Okan KON	Balıkesir University	EFFECT OF BUILDING SHELL ENVELOPES ON ENERGY CONSUMPTION OF COMPLEX UNIVERSITY BUILDINGS
Okan KON İsmail CANER	Balıkesir University	LIFE CYCLE EMISSION ANALYSIS DEPENDING ON ENERGY CONSUMPTION OF COMPLEX UNIVERSITY BUILDINGS
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Nigar Ahmedova Nazrin Zeynalli Gulnar Atakishiyeva Sevinc Mukhtarova Sima Musayeva Ilhama Hamdullayeva Abel Maharramov	Baku State University Azerbaijan Technical University	MAPPING OF BIOAVAILABILITY RADAR OF 4,4-DIMETHYL-2,6-BIS(TRICHLOROMETHYL)- 1,4-DIHYDRO-1,3,5-TRIAZINE
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Petek BALCI Yahya KAYA Süleyman ÖZEN Ali MARDANİ Ali KARA	Bursa Uludag University	SURFACE MODIFICATION of POLYPROPYLENE FIBRES with 1-VINYL-2- PYRROLIDONE & PERFORMANCE in CEMENTITIOUS SYSTEMS
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Saliha TÜRKMENOĞLU BERKAN	Gebze Technical University	SKETCHING IN THE DESIGN PROCESS AND DIGITAL TRANSFORMATION



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Mazlum GUNDUZ Burak Veli ULGER Eda YILDIZHAN Şehriban DURSUN DAĞ		APPENDICEAL ADENOCARCINOMA: CASE REPORT
Muhammed Mehdi ÜREMİŞ Deniz TUNCEL BERKTAŞ Nuray ÜREMİŞ Fatma İNANÇ TOLUN	Kahramanmaraş Sütçü İmam University	MEASUREMENT OF TELOMERASE ACTIVITY IN EPILEPSY PATIENTS AND THE RELATIONSHIP BETWEEN OXIDATIVE/NITROSATIVE STRESS AND TELOMERASE ACTIVITY
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Ahmed Osmane Khadija Zidan Moustapha Belmouden	Agadir University Ibn Zohr University Cadi Ayyad	NUTRITIONAL APPLICATIONS OF MILLET GRAINS FOR FOOD AND FEED PRODUCTION: IRRIGATION WITH TRICKLING FILTER-TREATED WASTEWATER IN SEMI-ARID CLIMATES
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Maha Atiq Muhammad Bilal Hussain Farhan Saeed Aliza Naeem Mariam Islam	Government College University	UNVEILING FLAXSEED'S BIOACTIVE COMPONENTS FOR EMERGING THERAPEUTIC INNOVATIONS



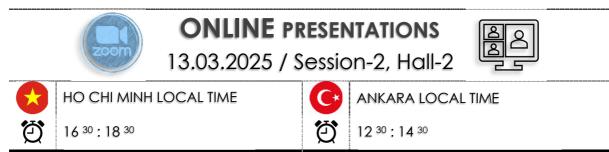
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BOUSLAH Mahmoud MAZA Mekki RAHMOUNI Zine EL Abidine TEBBAL Nadia	University of M'sila	INNOVATIVE APPROACHES FOR UTILIZING WASTEWATER TREATMENT BY-PRODUCTS IN ECO-EFFICIENT CEMENTITIOUS MATERIALS: A REVIEW
Ananda Majumdar	University of Alberta	THE ENDURING LEGACY OF MEDIEVAL MONSTERS: MARGINALIA, MEANING, AND MODERN INTERPRETATION
Hoang An Pham Do	Nguyen Tat Thanh University	SUSTAINABLE URBAN DEVELOPMENT IN ASSOCIATION WITH THE CONSERVATION AND PROMOTION OF THE VALUE OF SOUTHERN VIETNAMESE ANCIENT HOUSES
Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University Blida University	REDESIGNING PUBLIC SPACES FOR RESILIENCE: THE ROLE OF SOCIAL RESEARCH IN POST-PANDEMIC URBAN PLANNING
Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University Blida University	OPEN VS. ENCLOSED SPACES: A PSYCHOLOGICAL ANALYSIS OF HOW SPATIAL DESIGN INFLUENCES SOCIAL INTERACTION
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Ramazan AKDAŞ İlknur MAYA	Çanakkale Onsekiz Mart University	ANALYSIS OF STUDIES ON TEACHERS' ORGANIZATIONAL FIT
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Sevcan ÖLÇER	Harran University	UNDERGLAZED BLUE-WHITE AND MONOCHROME VIETNAMESE (ANNAMESE) CERAMICS (14th to 17th Centuries)
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HEAD OF SESSION: Pham Duc Thuan

AUTHORS	AFFILIATION	TOPIC TITLE
Moses Adeolu AGOI Oluwakemi Racheal OSHINOWO Aminat Oloruntoyin ABDULRASAK Benjamin Johnson OLASIJU Oluwanifemi Opeyemi AGOI	Lagos State University of Education	THE PEDAGOGICAL IMPACT OF MICROSOFT DESIGNER: A SURVEY ON EDUCATIONAL DEVELOPMENT
Moses Adeolu AGOI Oluwakemi Racheal OSHINOWO Yewande Adeyosola ODUNAYO Oluwanifemi Opeyemi AGOI	Lagos State University of Education	THE PROSPECTS AND CHALLENGES OF THE PEDAGOGICAL APPLICATION OF GENERATIVE AI: A SURVEY FOR EDUCATIONAL MANAGEMENT
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Koichumanova Gulzhan Kadyrovna	University Institute of Philology and Intercultural Communication	THE LEGACY OF SOCIALIST REALISM IN KYRGYZ POETRY AND THE ARTISTIC QUEST OF POETS IN THE 1970S-80S
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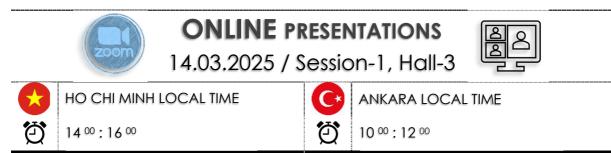
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Ayşe ARI Hatice SAPMAZ	Mersin University	POPULATION AGEING AND EXTERNAL DEBT: THE CASE OF EMERGING AND DEVELOPING ECONOMIES
Rabia TUNÇ Junus GANIEV	Kırgızistan-Türkiye Manas University	THE RELATIONSHIP BETWEEN THE EXCHANGE RATE AND INFLATION IN TÜRKIYE
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Ratinder Kaur Abdul Hadi Erfani	Punjabi University	MACROECONOMIC DETERMINANTS OF INDIA'S EXPORT PERFORMANCE IN A GLOBALIZED ECONOMY (1994 - 2024)
Mizanur Rahman	Gopalganj Science and Technology University	TECH SUPREMACY AND ECONOMIC WARFARE: THE U.SCHINA TRADE BATTLE IN THE 21ST CENTURY
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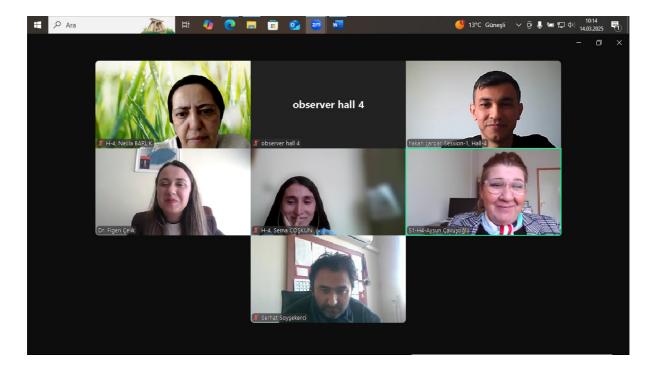


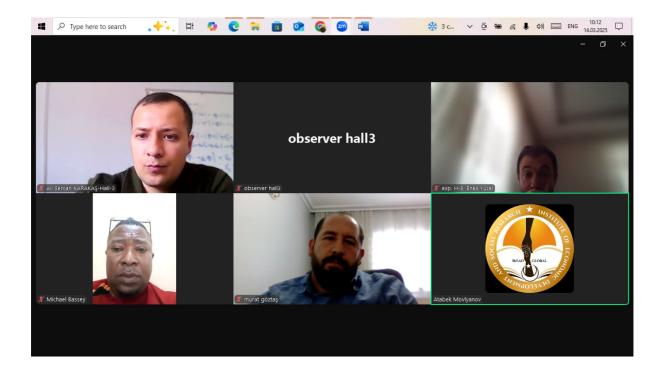










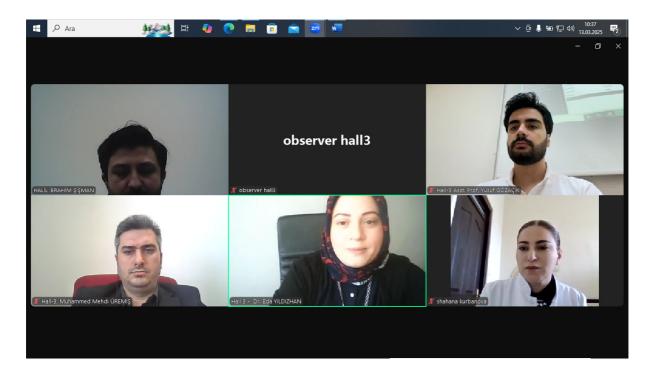


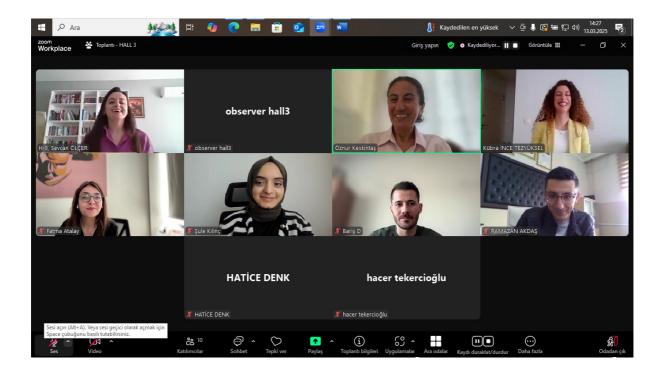


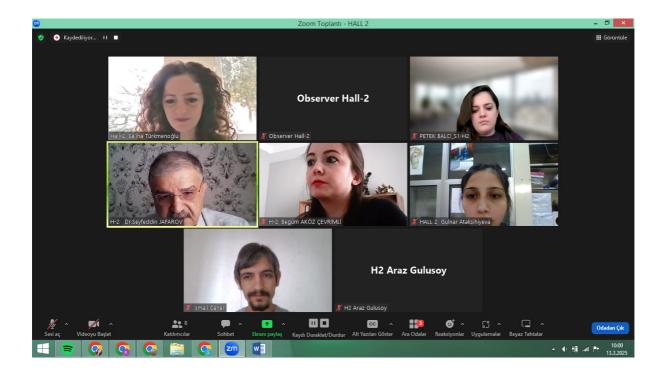












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THE USE OF BAMBOO AS A SUSTAINABLE AND ECOLOGICAL BUILDING MATERIAL IN ARCHITECTURAL APPLICATIONS: CURRENT APPROACHES AND INNOVATIVE SOLUTIONS

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ABSTRACT

The rapid increase in modern construction and the proliferation of environmental problems it brings have made the search for sustainable solutions in the construction sector inevitable. To eliminate or minimize these negative effects, the use of ecological materials in the construction sector is gaining more importance and becoming widespread each day. The preference for building materials with ecological properties that comply with sustainability principles plays a crucial role in reducing environmental damage by decreasing the harmful effects of buildings on the environment. In this direction, the ecological architectural understanding adopted in creating built environments continues to exist by renewing and strengthening itself with the continuous development of technology. This study aims to examine the role and importance of bamboo, which has come to the forefront among sustainable building materials in recent years, in creating sustainable architectures. The ecological advantages of bamboo as a building material and its potential for use in architecture constitute the main focus of this study. Within the scope of the research, architectural examples produced in various forms and constructions are examined when bamboo's physical and mechanical properties are combined with innovative technical details developed with today's technology. As a sustainable and ecological material, bamboo's use in architecture is continuously increasing thanks to its integration with developing technology. With this increase, bamboo contributes to both environmental and economic sustainability by providing energy efficiency at every stage of buildings' life cycle. Keywords: Bamboo, Ecology, Sustainability, Building material

SÜRDÜRÜLEBİLİR VE EKOLOJİK YAPI MALZEMESİ OLARAK BAMBUNUN MİMARİ UYGULAMALARDA KULLANIMI: GÜNCEL YAKLAŞIMLAR VE YENİLİKÇİ ÇÖZÜMLER

ÖZET

Günümüzde modern yapılaşmanın hızla artması ve beraberinde getirdiği çevresel sorunların çoğalması, yapı sektöründe sürdürülebilir çözümlerin arayışını kaçınılmaz kılmıştır. Bu olumsuz etkileri ortadan kaldırmak ya da minimum seviyeye indirgemek amacıyla, ekolojik malzeme kullanımı yapı sektöründe her geçen gün daha fazla önem kazanmakta ve yaygınlaşmaktadır.



Yapıların çevreye olan zararlı etkilerini azaltmak için sürdürülebilirlik prensiplerine uygun, ekolojik özelliklere sahip yapı malzemelerinin tercih edilmesi, çevresel zararların azaltılmasında önemli bir rol oynamaktadır. Bu doğrultuda, yapılı çevrelerin oluşturulmasında benimsenen ekolojik mimarlık anlayışı, teknolojinin sürekli gelişimiyle birlikte kendini yenileyerek ve güçlendirerek varlığını sürdürmektedir. Bu çalışma, sürdürülebilir yapı malzemeleri arasında son yıllarda öne çıkan bambunun, sürdürülebilir mimarilerin oluşturulmasındaki rolünü ve önemini incelemeyi hedeflemektedir. Bambunun bir yapı malzemesi olarak sahip olduğu ekolojik avantajlar ve mimarideki kullanım potansiyeli, bu çalışmanın temel odak noktasını oluşturmaktadır. Araştırma kapsamında, bambunun fiziksel ve mekanik özellikleri ve günümüz teknolojisiyle geliştirilen yenilikçi teknik detaylarla birleştiğinde, çok çeşitli form ve konstrüksiyonlarda üretilen mimari örnekleri incelenmektedir. Sürdürülebilir ve ekolojik bir malzeme olan bambu, gelişen teknoloji ile entegrasyonu sayesinde mimarideki kullanımı sürekli artış göstermektedir. Bu artışla birlikte bambu, yapıların yaşam döngüsünün her aşamasında enerji verimliliği sağlayarak hem çevresel hem de ekonomik sürdürülebilirliğe katkılar sunmaktadır.

Anahtar Kelimeler: Bambu, Ekoloji, Sürdürülebilirlik, Yapı malzemesi

1. Introduction

One of the important factors contributing to environmental problems is the intensive activities of the construction and building sector. The need to reduce this sector's negative environmental impacts has become inevitable for a sustainable future. This situation leads us to adopt ecological design principles in buildings and use environmentally friendly, ecological materials that respect natural resources [1]. The Earth is witnessing increasingly concerning developments in environmental context. Among these problems, ranging from climate change to loss of biodiversity, particularly the global warming issue is seriously straining the ecosphere and threatening natural balances. This situation reveals the need for urgent measures to be taken for the future [2].

Today's construction industry is turning towards innovative materials to reduce its ecological footprint and build more environmentally friendly structures, in line with growing environmental concerns and sustainability requirements. This transformation is characterized by traditional building materials being replaced by more sustainable alternatives. Bamboo has gained increasing importance in the field of sustainable architecture and has emerged as a notable alternative in the construction sector, especially in recent years. By combining modern construction technologies with traditional building methods, the use of bamboo offers new possibilities both aesthetically and functionally, while making significant contributions to the development of sustainable building practices [3-5].

Bamboo is a versatile plant that naturally grows in tropical and subtropical regions worldwide, capable of reaching an average annual growth rate of up to 91 centimeters, and due to this extraordinary rapid growth characteristic, it holds significant importance in terms of sustainable resource management. This plant has a wide range of applications in the construction industry, being preferred in various areas from interior decorations to large-scale exterior structural applications, from furniture design to flooring, and from garden landscaping to bridge construction. Bamboo stands out as a material with ideal properties in the construction industry due to its naturally high durability, fiber structure that can be as strong as steel, impressive flexibility, and notable lightness compared to traditional building materials.

2



These characteristics, along with its minimal processing requirements and low carbon footprint, are among the primary reasons why bamboo is preferred as a sustainable and environmentally friendly building material [3].

Compared to traditional building materials, bamboo presents an ideal option for architects and building designers looking to reduce their ecological footprint, with its qualities of being much more quickly renewable, requiring minimal water consumption during cultivation, and causing no harm to natural habitats. These characteristics make bamboo not only an environmentally friendly material but also a valuable resource in terms of economic and social sustainability. One of the important reasons for choosing bamboo as a building material is its contribution to the development of local communities and the spread of sustainable agricultural practices. With these features, bamboo offers a sustainable alternative to traditional building materials and is increasingly preferred in modern architecture. Thanks to both its aesthetic appearance and environmental benefits, it has become a preferred material especially in eco-architectural projects. The use of bamboo supports local economies and contributes to the construction of carbon-negative buildings [4-5].

This study will analyze the diverse applications of bamboo in architecture and examine its economic, environmental, and technical contributions to the sustainable construction industry as an ecological building material. Additionally, it will comprehensively address the challenges encountered in using bamboo in the construction sector and the innovative solutions developed to overcome these challenges, along with practical examples, shedding light on potential future applications.

2. Structural Properties and Engineering Characteristics of Bamboo: Its Importance as a Sustainable Building Material

Sustainable structures and environmentally friendly construction practices represent one of the most critical challenges facing the modern construction industry and are essential for reducing the sector's environmental footprint. While these practices promote the efficient use of natural resources, they also aim to minimize the negative environmental impact of structures. Today, the adoption of environmental sustainability principles in construction projects has become a fundamental part of our responsibility to leave a more livable, healthy, and balanced world for future generations. This responsibility contributes to the preservation of ecological balance at both local and global scales.

Bamboo is one of the natural building materials that stands out with its low carbon footprint and environmentally friendly production process. Offering a far more sustainable alternative compared to traditional building materials, bamboo draws attention with its superior properties. With its rapid renewability, high durability, and minimal environmental impact, bamboo holds a special place among sustainable building materials. Bamboo's natural structure makes it valuable both aesthetically and functionally, and it is obtained with much lower energy consumption and waste production compared to traditional construction materials.

2.1. Durability

Bamboo stands out as an extremely durable natural material with superior properties when compared to many traditional building materials used in today's construction industry. Thanks to its high tensile strength and compressive resistance properties, it finds wide application in the modern building industry. Due to its natural fibrous structure and flexibility, it shows high resistance against horizontal and vertical loads on structural elements.



These performance and durability characteristics are enabling bamboo to become increasingly preferred in modern building technology. Additionally, its high strength values relative to its own weight demonstrate bamboo's great potential as a sustainable building material in the construction sector and reveal the wide possibilities it offers for future applications. Bamboo is naturally flexible, durable, and lightweight material with some high strength properties. Its high tensile strength is due to its regular fiber structure. Bamboo columns and structures are flexible against external forces and generally show high resistance to bending forces without breaking. Bamboo's resistance to compression can also vary depending on its species and processing method. As shown in Table 1, bamboo's strength values are provided.

	Tubio 1. Strength values of Damboo	[0-0].
Tensile Strength	Bending Strength	Compressive Strength
350-600 MPa	140-170 MPa	50-100 MPa

Tablo 1. Strength Values of Bamboo [6-8].

2.2. Flexibility

Bamboo is a material that stands out for its natural flexibility. Thanks to this property, bamboo exhibits superior resistance against high tension and bending forces applied in vertical and horizontal directions. Bamboo's flexibility is particularly important in constructing earthquake-resistant structures in regions with intense seismic activity. The material's natural flexibility characteristic allows the structure to more effectively absorb horizontal and vertical forces that occur during earthquakes and distribute these forces evenly throughout the structure. Thus, it plays a crucial role in maintaining the integrity of the structure and increasing its earthquake resistance.

2.3. Growth

Bamboo is an important building material in the sustainable construction industry due to its rapid growth characteristics. Bamboo's growth rates can show significant variations depending on the plant's genetic structure, climate conditions of the region where it grows, soil structure, moisture level, and regular maintenance practices. However, when evaluated in general, bamboo's growth rate is at considerably higher levels compared to many other plant species, and this characteristic makes it stand out as a renewable resource.



1 4	510 2. Bamboo Growin Rales [4-5],[8-11].
	- Some bamboo species can grow up to 1 meter per day. This
Daily Growth	makes bamboo one of the fastest-growing plants in the world.
	One of the fastest-growing bamboo species, Phyllostachys
	edulis(Moso bamboo), can grow approximately 91 cm per day.
	-The annual growth rate of bamboo varies depending on the
Annual Growth	species and environmental conditions, but annual growth can
	typically range between 10-30 meters. This is particularly
	observed during bamboo's first 3-5 years of growth period.
	- The full maturation period of bamboo typically varies
	between 3-5 years. During this period, bamboo grows at its
Maximum Growth	fastest rate, but growth rate slows down when bamboo
Period	matures.
	- Reaching full size and maturity can take 5-7 years. However,
	while some bamboo species can grow faster, others may take
	longer.
	-The height of bamboo varies by species. For example,
	while Mosobamboo can grow up to approximately 20-30
Height	meters, cold-climate bamboo species like Fargesia are generally
	shorter, growing up to 3-5 meters.
	- Bamboo species with high growth potential can reach up to
	20-25 meters.

Tablo 2. Bamboo Growth Rates [4-5],[8-11].

2.4. Low Carbon Footprint

Bamboo production is much more environmentally friendly compared to traditional building materials. Particularly when compared to the production processes of materials like concrete and steel, the carbon emissions generated during bamboo cultivation and processing remain at very low levels. This is achieved through minimal fossil fuel usage in the production process and the bamboo plant's ability to absorb significant amounts of carbon dioxide from the atmosphere during its growth phase. Additionally, bamboo's rapid growth and renewable nature continuously increase its carbon sequestration capacity. When these characteristics come together, bamboo becomes a prominent option among sustainable building materials [3-5].

2.5. Waste Management and Recycling

Bamboo is an organic material that is biodegradable in nature. Thanks to this property, it can easily blend into nature and decompose in an environmentally harmless way after its service life ends. At the end of their useful life, bamboo products are broken down by microorganisms, enriching the soil and benefiting the ecosystem. Additionally, bamboo waste can be utilized as compost or used as raw material in the production of new products. The high durability of bamboo fibers ensures that new products made from recycled materials are also of high quality. As a result, waste bamboo can be utilized in various areas from pulp production to furniture manufacturing, creating a sustainable waste management cycle.

5



3. Physical Properties

3.1. Density

Bamboo is a natural building material that generally has low density. This characteristic emerges due to the hollow cellular arrangement in bamboo's internal structure. The density value can vary significantly depending on the bamboo species, harvest age, and moisture content. This low-density property makes bamboo a lightweight yet durable material preferred in the construction and furniture industries. The density values, which vary according to bamboo species, typically range between 300-800 kg/m³ [3].

3.2. Thermal Conductivity

Bamboo is an excellent insulation material due to its low thermal conductivity. Thanks to the hollow fibers and air gaps in its natural structure, it keeps heat transfer at a minimum level. This important characteristic makes bamboo a sustainable and environmentally friendly building material. With its thermal conductivity coefficient being at a low value of 0.11-0.14 W/m·K, bamboo becomes a more efficient insulation alternative compared to traditional building materials [3],[11].

3.3. Water Permeability and Water Absorption

Bamboo is known as a material with natural water absorption properties due to its inherent structure. Because of this characteristic, special protective measures and regular maintenance are required, especially when used in environments with high humidity levels. The natural water absorption capacity of bamboo material is approximately in the range of 20-30%. However, by applying various protective treatments and special surface coatings, the water resistance of bamboo material can be significantly increased and its resistance against moisture-related deterioration can be strengthened [12].

4. Challenges in Using Bamboo in Construction

4.1. Standardization Issues

Various challenges arising from bamboo's natural structure significantly complicate standardization in construction applications. The fact that each bamboo culm exhibits unique dimensions, shape, and quality characteristics makes it difficult to maintain consistency in production processes. Furthermore, natural variations in physical properties such as diameter, wall thickness, and node spacing of bamboo culms make it complex to establish and implement the standard measurement and quality criteria necessary for use in construction projects.

4.2. Durability Issues

Bamboo, due to its natural structure, shows sensitivity to various biological threats. Particularly pests such as insects, termites, and different types of fungi can threaten bamboo's structural integrity and significantly shorten its service life. These problems become more pronounced especially in humid and warm climates. Various protection methods must be applied to increase bamboo's durability. These include protective treatments with boron compounds, natural fungicides, and waterproof coating techniques. However, the application of these protection methods can increase costs and extend the application process.



4.3. Cultural Perceptions

One of the major obstacles in using bamboo as a construction material is societal perception and prejudice. In many regions, bamboo is traditionally seen as a symbol of poverty and temporary structures, and is perceived as a low-quality building material. This established perception makes it difficult for bamboo to be preferred among architects, contractors, and end-users, creating a significant barrier to its use in construction projects. This situation leads to bamboo's potential in modern building technologies not being fully realized.

4.4. Knowledge Gaps

One of the major challenges in using bamboo as a construction material is the lack of technical knowledge and practical experience. Comprehensive research and development efforts are needed for the effective use of bamboo in the modern construction industry. More detailed studies are particularly required in areas such as the design of bamboo-based building systems, engineering calculations, connection details, and implementation methods. Additionally, it is crucial to adapt existing building regulations and safety standards to accommodate bamboo usage, develop testing procedures, and establish certification systems. Addressing these deficiencies will pave the way for more widespread and secure use of bamboo in the modern construction industry.

5. The Use of Bamboo in Architectural Applications and Sustainable Building Solutions

There are examples of bamboo usage in many different structures from traditional to modern. Bamboo usage is particularly widespread in Southeast Asian traditional architecture, indigenous communities of South America, and rural regions of Africa, creating an architectural tradition blended with construction techniques passed down through generations. In these regions, bamboo is preferred as a building material that is suitable for local climate conditions, economical, and sustainable.

5.1. Structural Use

Bamboo can be used in construction as frame systems, load-bearing posts, columns, and wall elements. Due to its natural flexibility and high strength-to-weight ratio, it is preferred in creating earthquake-resistant structures. Additionally, it is utilized as a decorative element in many architectural designs for both interior and exterior spaces, offering aesthetic solutions particularly in ceiling coverings, partition walls, and landscape arrangements.





Figure 1. Bamboo ceiling covering [URL-1].



Figure 2. Bamboo landscape view [URL-2].





Figure 3. Bamboo support poles [URL-3]

5.2. Modern Bamboo Structures

In today's modern architecture, bamboo stands out as an environmentally friendly, sustainable, and aesthetically appealing building material option. Bamboo houses, bridges, hotels, and public buildings constructed with innovative design approaches demonstrate the wide range of possibilities bamboo offers for modern structures. These buildings prove bamboo's durability and aesthetic value by combining traditional construction techniques with contemporary engineering solutions. Particularly preferred in ecotourism facilities and sustainable architectural projects, bamboo is considered the building material of the future with its low carbon footprint and rapidly renewable characteristics.



Figure 4. Bamboo interior view [URL-4].

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Figure 5. Bamboo interior view [URL-4].



Figure 6. Bamboo building view [URL-4].

6. Conclusion

Bamboo stands out as a versatile, innovative, and environmentally friendly material shaping the future of sustainable construction industry. This natural resource possesses superior properties compared to traditional building materials and offers numerous opportunities for sustainable use of natural resources through both environmental and structural advantages. This innovative building material, which contributes to the preservation of ecological balance, holds an important place in the construction sector. With its durability, flexibility, and renewability features, this material in the construction industry enables sustainable use of natural resources through both environmental and structural advantages. It provides an effective solution to environmental problems caused by traditional building materials while contributing to the development of sustainable construction technologies. At the core of this transformation, bamboo has the potential to change traditional approaches in the construction sector by standing out as both a durable and environmentally friendly building material, thanks to its natural properties not found in other building materials.



Bamboo, which stands out with its rapid growth characteristic compared to traditional tree species, carbon footprint, and extraordinary durability, is increasing its importance and value in the construction industry day by day due to being renewable among sustainable building materials from the simplest traditional construction techniques to the most complex modern architectural applications, requiring minimal maintenance, and having low environmental impact.

Increasingly preferred by construction engineers, architects, and building experts for its superior properties, bamboo will play an even more decisive role in future construction applications. With the rapidly increasing global demand for sustainable building materials, the widespread use of bamboo is now inevitable. Along with cutting-edge engineering solutions and continuously evolving innovative construction technologies, bamboo will find a much wider range of applications in the construction sector as a material that significantly increases the environmental sustainability of buildings, stands out with its striking aesthetic appearance and structural strength, while also offering long-term economic advantages. In light of these developments, bamboo's role in the future of sustainable building materials will continue to grow in achieving environmental sustainability goals, reducing carbon footprint, and preserving natural resources. Thanks to its rapid growth characteristic, high durability, and renewable nature, bamboo will have an indispensable position in the sustainable future of the modern construction industry.

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LITHIUM CHLORIDE INDUCES MITOPHAGY AND INCREASES INTRACELLULAR INTERMEDIATE FILAMENTS IN 3D ISHIKAWA SPHEROID CULTURES

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Abstract

Lithium chloride (LiCl) is a chemical commonly utilized to treat neurological diseases, and its effects on cellular communication pathways are being studied. The purpose of this study is to determine the effects of lithium chloride (LiCl) on Ishikawa cells. Various LiCl dosages (1, 10, and 50 μ M) were used to test the effects on cell viability, proliferation, mitophagy, and colony formation. Cell viability was confirmed by counting cells, proliferation was evaluated using BrdU staining, mitophagy and ultrastructural changes were examined using electron microscopy, and colony formation was examined. Two-way ANOVA was used in the statistical analysis. The findings suggest that high-dose LiCl treatment reduces cell survival and colony formation while increasing intracellular intermediate filament accumulation via mitophagy. Furthermore, LiCl may stimulate cellular stress responses and autophagic processes. The study demonstrates that further molecular and biochemical studies are required to understand the effect of LiCl on cell dynamics.

Material- Method

Ishikawa cells were used in the experiment. Cells were grown for 24 and 72 hours and treated with LiCl dosages of 1, 10, and 50 μ M. Cell viability was determined by counting dead and live cells using Trypan blue staining. Cells were grown for 4-6 days to determine colony development, and cell aggregates of 30 cells or more were designated colonies. The BrdU staining technique was used to measure cell division during the proliferation analysis. Mitophagy examination was performed through monitoring mitophagic cell death and intracellular ultrastructural modifications with electron microscopy. In the statistical analysis, the two-way ANOVA approach was utilized, and significant differences were found using post-hoc testing.

Discussion

The results suggest that lithium chloride has a dose-dependent effect on the proliferation, mitophagy, and colony formation of Ishikawa cells. Cell viability decreased significantly, particularly at 50 μ M doses. Electron microscopic analysis demonstrated that high LiCl dosages caused mitophagy, resulting in an accumulation of intracellular intermediate filaments. This might be comprehend as lithium inhibiting the cell cycle, activating autophagic mechanisms, or causing a stress response. Previous research shows that lithium has an effect on cell development and differentiation. Yet further molecular investigations are necessary for a complete understanding the process.



Conclusion

This study suggest that high dosages of LiCl decreased Ishikawa cell growth and colony formation while increasing mitophagy and causing intracellular intermediate filament accumulation. The findings demonstrate that further study is needed in order to comprehend the effects of lithium on cell viability.

Keywords: Lithium Chloride, Ishikawa Cells, Electron Microscopy, Intermediate Filaments, Cellular Stress.



ARTIFICIAL INTELLIGENCE VERSUS NATURAL INTELLIGENCE

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Abstract

Artificial intelligence, the latest popular product of technology, is discussed as a tool that makes decisions and directs life instead of humans and causes anxiety. The process of simulating basic human abilities (movement, perception, learning) is difficult but ongoing. Robots designed based on human models are likely to act more intuitively and understandably for humans. In particular, this greatly simplifies human-robot interaction. Numerous authors and researchers, albeit from completely different perspectives, seem to agree on the idea that it is nearly impossible to have true "intelligence" without some form of "consciousness." This is the image that a human consciousness is required for every natural thing that is artificial. The rise of artificial intelligence has reached such a scale that it now directly affects human intelligence and poses an immediate global challenge to it. The idea of artificial intelligence is fundamentally based on the idea and concept of machines developing the ability to think, act and behave like humans. John Mc Carthy is considered the father of artificial intelligence as he is the one who invented this terminology. The process of critically examining and classifying the abilities of artificial intelligence systems to think and act as an independent decision-making authority is still ongoing.

Keywords: Artificial intelligence, robot, technology, human.

Introduction

In the history of European philosophy (e.g. by Aristotle, Hume or Mill) it has often been stated and pointed out that the seemingly innocuous concept of 'nature' is difficult and vague (Bayertz, 2017: 10). Human intelligence has shaped the world in profound ways, driving innovations in science, technology, art, and government, while artificial intelligence has revolutionized industries such as healthcare, finance, transportation, and entertainment, providing unprecedented capabilities in data analysis, automation, and decision-making (Sfetcu, 2024: 12).). Thus, the Transhumanism and Posthumanism phases were passed (Loh, 2020). At every stage, human intelligence has moved further and created a more artificial world.

According to the Darwinian principle of diversity and natural selection, human beings, one of thousands of species that emerged during the evolution process, are a part of nature. However, it has a feature that distinguishes it from all systems in nature: it has the ability to create things that are no longer part of nature. Although objects such as tools, buildings, musical instruments or books are part of the physical world, they do not belong to nature because they are artificially produced and therefore, according to common usage, they are the opposite of what is natural (Leumann, 2024: 22). During the evolution process, humans moved away from nature and preferred artificial life. Artificial life is constructed by living objects, which are part of the natural life process, and whose features emerge as a result of external assumptions, not internal limitations (Gecow, 2008: 199). Over time, the human mind has become an expert in producing artificial objects.



"Australian performance artist Stelarc has been interested in the relationship between humans and machines throughout his career, initially exploring psychological and physical extremes, pushing his body to its limits in several performances, and continuing to explore new ways in which contemporary technology can relate to his body. In this way, he connected to his body through interfaces or used it to change his physical state; He presented himself as a pioneer of a human being who left behind the shackles of the natural body and became post-human. This is technologically transformed rebirth (Vollert, 2012: 13). It has also been much discussed to what extent Stelarc's body concept addresses the dilemma of naturalness and artificiality, and how he alienates his biological body into a "highly artificial but living sculpture" in his performances. Living organisms have long been a source of inspiration for humans to build artifacts that mimic their behavior. The models generally used are quite simple compared to natural sources of inspiration. However, in computers, both realistic and non-speculative approaches are also possible from a biological point of view. On the one hand, there are models used as tools in engineering, especially for optimization, and on the other hand, there are environments and models that show properties similar to those observed in bio-organisms that are useful for studying and developing biological theories (Correia, 2010: 794). Artificial neural networks, evolutionary algorithms, artificial biologically inspired tools such as immune systems, swarm-based algorithms and computer-based models such as artificial living environments and autonomous robots, artificial beings, synthetic biology, whether living organisms can be artificially produced in a very short time and therefore, it triggered an intense debate about whether life has lost its special status compared to technological products (Lüke, 2016: 152). While the discussions continued, synthetic production continued. Contemporary artificial life (also known as "ALife") is the interdisciplinary study of life and life-like processes. Its two most important features are that it focuses on the fundamental characteristics of living systems rather than their coincidental properties, and that it tries to understand living systems by artificially synthesizing their extremely simple forms. These two features are interconnected. By synthesizing simple systems that seem very alive but are also very alien, artificial life constructively explores the limits of what is possible for life (Bedau, 2003: 509). It has been possible to specifically intervene in the DNA of living organisms for more than 40 years. Biotechnology has made rapid progress and is constantly changing. In the 1980s people spoke of "genetic engineering", then "genomics" around the time of the sequencing of the human genome, and "systems biology", among other things (Allgöwer et al., 2005: 37). Initially, synthetic biology was concerned with treating (micro)organisms such as bacteria as small computers with replaceable parts and genes as electronic components, but it has gradually evolved.

"The philosopher Picht says that "nature permeates and surrounds everything we can think of, and our thought seems to have no beginning or end." He claims that nature is not limited only to our environment, but that humans themselves are also a part of it. From this it can be concluded that everything that humans can produce automatically comes from nature. So all kinds of technology will be a natural thing. In contrast, there is the claim that what is considered "nature" today is almost always unnatural: gardens, wheat fields, pastures where cows graze, and even wildlife parks are human-made, made up of living things (Eberle and Roscher, 2019: 41). The real problem is that the human mind is capable of producing artificial versions of every natural element in life.

The concept of "naturalness" often plays an important role in the public debate about chemicals in the environment (and in food). This concept is mainly known in daily life from supermarkets.



Many products advertise that they contain only "natural" ingredients and no "artificial" additives. According to market research company Mintel, more than every third newly approved food product in Europe already contains this or a similar "naturalness claim", as it is called in marketing language, and this trend is increasing (Schnurr, 2012: 100). Because now, artificial versions of everything that is natural are produced.

"Evolution only makes sense in the context of entire populations; It is not defined for individuals. The field of artificial evolution was founded in the 1960s by Ingo Rechenberg in Germany and John Holland and L.J. in the United States. It began with the developments of Fogel, Holland's type of evolutionary algorithms called genetic algorithms or GAs, Fogel's evolutionary programming or EP, and Rechenberg's evolutionary strategies or ESs. While Holland was interested in adaptation in natural systems, Fogel and Rechenberg were more interested in utilizing evolutionary algorithms for optimization. They all shared a strong belief in the power of evolution" (Pfeifer et al., 2001: 81). The last major transition from natural to artificial occurred with artificial intelligence, and eventually devices that think and decide instead of humans emerged.

Development of Artificial Intelligence

Rapid increase in computing power of computers; economics, research and, last but not least, communication via social media generate large amounts of digital data. Intelligence is based on sensory perception, especially visual perception. Many experts in this field believe that 80 percent of what people learn every day comes from their eyes. Here certain patterns are created that determine thoughts. Newly emerging perceptions constantly try to interact with these patterns, complete or rearrange the stored ones (Dengel et al., 2019: 15). While human nature has the potential and power to do these things, the same mind has designed machines that think and act instead of itself.

Artificial intelligence is one of the most important and distinctive technological innovations that is reshaping all aspects of human life, starting from magnitudes such as shopping, data collection, driving, daily life, medical approach and many more. Artificial intelligence is now widely used in services, from back-office tasks to front-line interactions with customers (Bolton et al., 2018: 53). Prejudice, credibility and transparency are important issues in the hypermodern age, with intelligent systems generally representing greater objectivity and impartiality in implementation and decision-making (Bitkom e. V., 2017: 161). In the hypermodern age, where traditional tools and values are left behind, tools that make decisions on behalf of humans have begun to dominate life.

"Since birth, people have been trying to replace the functioning of a part of the human brain with machines, according to the contemporary level of knowledge and technical conditions. After a long period of development of science and technology, until the beginning of the 20th century, some groundbreaking studies were carried out in the field of artificial intelligence. A historic conference held at Dartmouth College in the United States in 1956 has been regarded as marking the birth of the science of artificial intelligence. During the conference, McCarthy formally introduced the concept of artificial intelligence, which includes mathematics, computers, neurophysiology, psychology and other disciplines. From that point on, artificial intelligence technology began to develop as a formally emerging discipline" (Cao, 2017: 701). Artificial intelligence has always been at the forefront of computer science, and its theories and results are approaching the level that can greatly control science and technology and determine the direction of computer technology development.



Artificial intelligence is the ability of a machine to imitate human abilities such as logical thinking, learning, planning and creativity. Artificial intelligence enables technical systems to perceive their environment, deal with what they perceive, and solve problems in order to achieve a certain goal. Artificial intelligence systems can adapt their actions by analyzing the results of previous actions and working autonomously (Artikel, 2023: 5). In a robotic world, robots do many of the jobs of humans and seem to make life easier. Human beings, who are always in favor of the easy by nature, prefer a life dominated by smart machines (Braun et al., 2018: 22). Man, who has reached the digital age from the plow, lives in an age where the highest technology dominates life.

The central developments and technical foundations of artificial intelligence, its capabilities in certain fundamental areas that are particularly formative for humans, such as recognition, learning or action, and the idea of machines that resemble or even exceed human capabilities can be traced back to Greek mythology, dating back thousands of years before the invention of software systems. With the construction of the first computers in the 20th century, the existence of machine intelligence became accessible for the first time. In 1950, mathematician Alan Turing formulated a criterion for artificial intelligence, later known as the Turing test; Accordingly, machine intelligence will exist if the behavior of a machine appears to human observers to be indistinguishable from that of a human. Early research on artificial intelligence assumed that human learning or intelligence could be described in enough detail that a machine could be built to simulate it. From the very beginning, specific AI research topics that still play a role today include pattern recognition, language processing, abstraction ability, creativity, and flexible problem solving (Deutscher Ethikrat, 2023: 12). Actions that humans have been doing with their minds for hundreds of thousands of years are now performed by machines.

Social networks, robotics, and artificial intelligence are viewed as techniques of human culture that themselves become cultural environmental factors of human social behavior. High technology has created a new cultural life in the world with vehicles that think and act like humans (Funk et al., 2020: 37). Just as the computer replaced the typewriter, artificial intelligence is expected to replace many human actions.

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BEAUTY AND ISLAM: AN INVESTIGATION ON THE ETHICAL DIMENSION AND HORIZONS OF ISLAMIC AESTHETICS

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ABSTRACT

Beauty is a fundamental value in Islam, as understanding beauty is akin to understanding existence itself. In Islamic teaching, beauty is an inherent truth that cannot be invented or created afterward. Within this thought system, beauty is a divine attribute. According to the principle of "tawhīd" (the oneness of Allah), all beauty belongs to Allah; nothing other than Allah is truly beautiful, or it is beautiful only to the extent that it serves as a reflection of His beauty. Islamic thought, which perceives beauty as a part of morality, was born and developed within the framework of this understanding.

This study examines the relationship between Islam and beauty from an ethical perspective and aims to deepen this understanding in light of the unique characteristics of Islamic aesthetics. By exploring the essence of beauty through the perspectives of Al-Ghazālī and Ibn Sīnā, the study addresses its central inquiry under three subheadings: "The Relationship Between Beauty, Goodness, and Usefulness"; "Beauty as a Reflection of Knowledge and Truth"; and "Grandeur as a Sign of Absolute Beauty and Sublime." In this doctrine, truth, beauty, and goodness are ultimately the same: what is beautiful is true, what is true is beautiful, what is both true and beautiful is good; what is beautiful and good is useful, and what is useful is moral.

Keywords: Absolute Beauty, Aesthetics and Ethics, Goodness, Usefulness, Grandeur

INTRODUCTION

To comprehend beauty is to grasp the essence of existence itself. In Islamic thought, beauty is not merely an aesthetic experience but an integral part of morality, embedded within a broader intellectual pursuit of understanding. This pursuit, however, is not driven by the desire for possession but rather by an awareness of belonging. Such an epistemological foundation has shaped the perception of beauty within Islamic philosophy. Within this framework, beauty is not something that can be artificially fabricated or innovated; it exists inherently, awaiting recognition and engagement by the artist, whose role is to seek and reveal its given presence.¹

The concept of beauty is deeply intertwined with the understanding of being. In both ancient Greek and medieval thought, beauty was closely linked to the perception of the divine, extending beyond mere sensory perception (*aisthesis*) to a metaphysical realm. Unlike contemporary interpretations that often confine beauty to the sensory domain, earlier discourses acknowledged its transcendental dimension. While Islamic aesthetics absorbed certain influences from Greek artistic and philosophical traditions, these ideas were neither uncritically adopted nor allowed to overshadow its indigenous conceptual framework.

¹ Mustafa Uğur Karadeniz, İslam Sanatlarında Estetik- Güzeli Anlamak (İstanbul: Ketebe Yayınları, 2020), p. 9.



Instead, they were synthesized with original contributions, resulting in a distinct artistic and aesthetic vision unique to the Islamic intellectual tradition.²

Given this foundation, an in-depth exploration of the subject is necessary to elucidate the originality of Islamic aesthetics, particularly due to the centrality of beauty within its doctrinal and artistic expressions. Beauty is an intrinsic value in Islam, bearing profound significance. Al-Ghazālī and Ibn Sīnā articulate that the essence of beauty lies in the acknowledgment and submission to perfection, whereby all entities possess their own ideal form. However, external beauty serves merely as a gateway to deeper, intrinsic beauty. The human eye can perceive only the outward form, while the heart is endowed with the capacity to penetrate its essence. Moreover, the perception of beauty, clarity, and harmony is contingent upon knowledge, which extends beyond the confines of sensory experience.³ A heightened awareness of realities beyond the material realm elevates an individual toward the state of the *perfect human being*, enabling a deeper and truer apprehension of beauty.⁴

Ibn Sīnā asserts, "The beauty (cemāl) and splendor (bahā) of all things consist in that everything has to be as it has to be." ⁵Similarly, Al-Ghazālī contends, "The beauty and goodness of everything lie in the realization of its unique competence as much as possible."⁶

Thus, aesthetic qualities are relative; the attributes that render a horse beautiful are distinct from those that define human beauty. According to philosophical thought, four essential conditions underpin beauty: flawlessness, moderation (harmony and proportionality), order, and purposefulness (the pursuit of a noble existence). This perspective finds resonance in the Qur'anic verse:

"Who has created seven skies, one over the other. You will see nothing out of proportion in the creation of the Rahmān (the All-Merciful). So, cast your eye again. Do you see any rifts? Then cast your eye again and again, and the eye will come back to you abased, in a state of weariness" (Al-Mulk, 3–4).

In Islamic thought, beauty is regarded as a divine attribute. Rooted in the principle of *tawhid* (oneness), this perspective asserts that all beauty belongs ultimately to Allāh, and nothing possesses inherent beauty except insofar as it serves as a conduit for divine splendor. Affifi highlights that Ibn Arabī—one of the most audacious figures in Islamic mysticism whose influence was particularly pronounced in the eastern Islamic world and Anatolia—conceived the cosmos as comprising both an apparent, exoteric dimension and a concealed, esoteric reality. According to Ibn Arabī:

The visible physical world mirrors the invisible. God is the invisible world, and He is reflected through His creation in the visible world. Following Platonic concepts, according to which love is the prime mover of all things toward the beautiful and the eternally perfect, he conceived beauty as the cause of all love. One loves God because He is beautiful, and He loves us and all His creation because He loves beauty. He is Himself the lovable lover and beloved and thus the origin and the end of the cosmos. God's beauty is the source of all beauty, the physical, spiritual, and intellectual.

² Karadeniz, 17.

³ İlhan Kutluer, *İslam Entelektüel Geleneğinde Estetik Perspektifler* (İstanbul: TDV VI. Religious Publications Congress Proceedings, 2013), p. 65.

⁴ İmam Gazali, İhya-ı Ulumidin, Vol. IV, trans. Ali Süleyman (Kahire, 2005), p. 357.

⁵ Valerie Gonzales, *Beauty and Islam* (London: I.B. Tauris, 2001), p. 33.

⁶ Kutluer, 63.



He should be worshiped through all forms of beauty, including the temporal one. Beauty is powerful and attracts love and desire; the sympathy between humanity and the universe is based upon love (ishq).⁷

A more comprehensive analysis of the relationship between Islam and beauty is examined in the following sections.

INTERRELATEDNESS OF BEAUTY, GOODNESS, USEFULNESS

Classical philosophers categorized human intellectual activity into three fundamental pursuits: the search for truth, beauty, and goodness. These pursuits correspond to three primary types of judgment—cognitive, aesthetic, and ethical—which, in turn, serve as the foundations of three major branches of philosophy: metaphysics, aesthetics, and ethics. While metaphysics concerns itself with the nature of existence, aesthetics explores beauty, and ethics examines moral virtues. Initially, both ethics and aesthetics were embedded within philosophical inquiry, but over time, they diverged and established themselves as distinct disciplines with their own methodologies and frameworks. However, both fields engage with similar fundamental categories: aesthetics interrogates sensory-emotional values—often referred to as judgments of taste—while ethics examines moral values.⁸

Two principal approaches emerge concerning the relationship between ethics and aesthetics, or the concepts of goodness and beauty. The first, rooted in antiquity, argues for an intrinsic link between the two, asserting that beauty and art must be inherently tied to moral principles. Within this perspective, art is seen as a vehicle for disseminating ethical values, reinforcing the notion that artistic expression should uphold and validate moral ideals. The second approach, by contrast, insists on maintaining a clear distinction between ethics and aesthetics, safeguarding the autonomy of beauty from moral constraints. Proponents of this view caution against subordinating aesthetics to ethical considerations, warning that such an approach risks reducing art to a mere instrument of morality, thereby stripping it of its independence and intrinsic value.⁹

Plato, one of the foremost thinkers of antiquity, regarded beauty, goodness, and righteousness as interconnected, considering them to be aspects of a unified truth. His discourse on beauty extends beyond physical appearance, emphasizing the virtues of the soul and the ethical dimensions of human action. Central to his philosophy is the idea that "goodness" serves as the fundamental principle from which ethical, aesthetic, and epistemological values are derived. Plato's framework underscores the unity and inherent virtue of Absolute Beauty.¹⁰

Aristotle, though recognizing aesthetic experience as rooted in sensory perception, argued that art should ultimately lead to a moral purification, achieved particularly through the cathartic power of tragedy. This transformative effect of art, he believed, played a crucial role in the moral elevation of its audience.¹¹

¹¹ Arat, 88.

⁷ E. A. Affifi, *The Mystical Philosophy of Muhyid Dīn-Ibnul 'Arabī* (Cambridge, 1939), p. 173.

⁸ Ayşe Taşkent, *Estetik ve Etik Değerler Bütünlüğü* (İstanbul: TDV VI. Religious Publications Congress Proceedings, 2013), p. 74.

⁹ Ayşe Taşkent, *Güzelin Peşinde (Fârâbî, İbn Sînâ ve İbn Rüşd'de Estetik)* (Klasik Publishers/Islamic Philosophy Series, 2013), p. 57.

¹⁰ Necla Arat, *Etik ve Estetik Değerler* (İstanbul: Telos Yayıncılık, 1996), p. 88.



Similarly, Plotinus, drawing upon the Greek philosophical tradition, contended that beauty, goodness, and righteousness were fundamentally interconnected. He maintained that these concepts were not only relevant to the material world but also held profound significance for human existence.

For Plotinus, art was not merely an aesthetic endeavor but a bridge to the transcendent and spiritual realm, serving as a conduit for understanding the divine. In his system, aesthetic experience functioned as a pathway to the One, the Good, and ultimately, to God—imbuing beauty with a moral and mystical dimension.¹²

The interconnection between beauty and morality persisted beyond classical antiquity and the medieval period, shaping 18th-century moral philosophy. Shaftesbury famously asserted that *"Beauty is virtue and goodness,"* arguing that aesthetic and moral values are inherently intertwined. His ideas influenced Kant, who, while distinguishing beauty as a purely aesthetic phenomenon, acknowledged its potential association with moral virtue. Kant maintained that although beauty and moral goodness are distinct, they share a symbolic relationship within the empirical world. In this sense, beauty operates as an allegory of moral virtue, reflecting ethical ideals through aesthetic form.¹³

The conceptual overlap between beauty and goodness is also evident in the intellectual tradition of Islamic philosophers. As Taşkent notes, while Islamic thinkers did not regard these concepts as entirely synonymous, they recognized a strong correlation between them. This perspective is particularly pronounced in the writings of Al-Fārābī, Ibn Sīnā, Averroes, and Al-Ghazālī. The integration of moral values into aesthetic thought among Islamic philosophers reflects the broader intellectual inheritance of both classical antiquity and the medieval period. However, Islamic thought extends this association further, linking the concept of beauty not only to ethics but also to divine attributes. Within this framework, God is described as the embodiment of Absolute Goodness, possessing attributes such as *cemāl*, *bahā, zynah*, and *husn*.¹⁴

The terminology employed by Islamic philosophers in discussions of aesthetics is deeply rooted in Qur'anic discourse. The Qur'an presents numerous terms associated with beauty, including *bahā*, *husn*, *ihsān*, *zynah*, and *behce*, while also describing the impact of aesthetic experiences with concepts such as continuity (*istimrar*), wonder (*ta 'accub*), and visual delight (*lezzetü'l 'ayn*). Moreover, Qur'anic references to beauty extend beyond material form, encompassing moral and spiritual virtues—exemplified in expressions such as "beautiful patience," "beautiful migration," and "treatment with beauty."¹⁵

The intersection of aesthetics and morality is also evident in Islamic theology and mysticism. According to the Mu'tazilah school of theology, religiously prescribed beauty aligns with rational conceptions of beauty. Meanwhile, the Ahl as-Sunnah tradition asserts that religion serves as the definitive criterion for distinguishing between beauty and ugliness, both in moral and aesthetic realms. From a Sufi perspective, however, beauty and ugliness are subjective rather than absolute categories. In ontological terms, existence itself is seen as perfect, with all beings serving as reflections of divine beauty and as manifestations of God's oneness.

¹² Arat, 88.

¹³ Taşkent, Estetik, 75.

¹⁴ Taşkent, Estetik, 75.

¹⁵ Taşkent, Estetik, 76.



This perspective is rooted in the well-known *Hadith Qudsi*: "*I was a hidden treasure, and I wished to be known, so I created a creation (mankind), then made Myself known to them, and they recognized Me.*" Within Sufi thought, absolute beauty is regarded as an eternal attribute of God, who first beheld His own beauty before manifesting it in the external world through creation. The culmination of this divine beauty is embodied in the figure of Prophet Muhammad, whose perfection serves as the ultimate exemplar of aesthetic and moral excellence. As the Prophet himself stated, "*I was sent to perfect good character.*" In this framework, true beauty is attained through moral purification (*tazkiyah*) and the refinement of the soul.¹⁶

The continuity of thought linking ethics and aesthetics-from antiquity through the Middle Ages, the 18th century, and Islamic intellectual tradition-demonstrates that these two domains cannot be entirely separated. Within Islamic philosophy, moral and natural beauty are conceived as manifestations of divine benevolence. The harmony between beauty and goodness derives its ultimate significance from its connection to truth. The notion that beauty exists independently of goodness poses profound contradictions within the Islamic epistemology of truth. Consequently, in Islamic thought, beauty, goodness, knowledge, and truth are deeply interwoven, forming an indivisible whole. As Al-Ghazālī observed, aesthetic experience encompasses not only perception but also knowledge, spiritual states, and actions. Attempting to isolate these dimensions inevitably diminishes their true value. Koç provides a compelling critique of the modern tendency to separate ethics from aesthetics, illustrating the flawed consequences of such a dichotomy. He argues that in contemporary thought, beauty is reduced to a matter of sensory perception, while goodness is confined to ethical behavior. This division, he notes, can lead to troubling conclusions—such as evaluating an intricately designed bomb as "beautiful" regardless of its destructive purpose. Even if one were to momentarily accept such a notion, would it not be essential to question the intention behind its creation? Koç contends that acknowledging such an object as "beautiful" instinctively disrupts one's moral intuition.¹⁷ His argument underscores the dangers of divorcing aesthetics from ethics and reducing beauty to a purely visual or sensual phenomenon-an error that Islamic aesthetics explicitly avoids.

In Islamic aesthetic philosophy, beauty is inherently connected not only to goodness but also to utility. The Qur'an makes no distinction between beauty and usefulness, emphasizing their intrinsic relationship. This perspective is reflected in Islamic artistic traditions, where the mastery of craft lies in resolving both aesthetic and technical challenges simultaneously. Within this paradigm, science and art are two complementary aspects of the same intellectual tradition. For instance, a belt must not only be visually appealing but also durable and functional. Likewise, architectural structures must serve their intended purpose, possess structural integrity, and evoke aesthetic appreciation. Within this framework, beauty is not an isolated phenomenon but rather an essential component of perfection. In Islamic aesthetics, beauty, goodness, and utility are seen as interdependent, existing in harmony rather than as separate entities. This integrative approach constitutes the defining characteristic of Islamic aesthetic thought.¹⁸

¹⁶ Ramazan Altıntaş, İslam Düşüncesinde Tevhid ve Estetik İlişkisi (İstanbul: Pınar Publishers, 2002), p. 29.

¹⁷ Turan Koç, "The Vision of Islamic Art and Aesthetics," *Journal of Academic Studies* 2 (February 2010): 35–47, https://dergipark.org.tr/tr/pub/eskiyeni/issue/37266/430499 (accessed 15.03.2025).

¹⁸ Turan Koç, İslam Estetiği (İstanbul: İSAM Yayınları, 2019), p.87.



BEAUTY AS A REFLECTION OF KNOWLEDGE AND TRUTH

At its core, art is an expression of beauty, yet in Islamic art, beauty serves a higher purpose it functions as a conduit to truth, manifesting both outwardly and inwardly. Unlike in some artistic traditions where pure visual beauty is pursued for its own sake, Islamic art does not regard beauty as an independent goal. Instead, beauty emerges as a natural outcome of striving for perfection and adherence to truth. The primary concern in artistic creation is not merely aesthetic appeal but the realization of goodness, accuracy, truthfulness, and perfection. Consequently, visual beauty, particularly when confined to form alone, is considered relative and secondary within Islamic aesthetics.¹⁹

Ahmet Atan highlights this principle, asserting that the value of Islamic aesthetics is determined not by physical representation but by its capacity to convey deeper meaning. In Islamic thought, all visual imagery is earthly, impermanent, and transient—a perspective that closely aligns with Sufi philosophy. From a Sufi standpoint, the material image itself holds little significance; rather, what matters is the ultimate truth and reality behind it. A visual representation that contradicts Islamic principles, even if aesthetically pleasing, does not align with the essence of Islamic aesthetics. Beauty that is subject to decay and impermanence cannot be fully integrated into the Islamic aesthetic framework. If an understanding of beauty is confined to worldly values and does not resonate with the eternal nature of the afterlife, it remains outside the realm of Islamic aesthetics. Within this paradigm, beauty is not merely the antithesis of ugliness but a sacred mystery—an attribute of existence that carries profound spiritual significance and reflects the majesty and splendor of Allāh.²⁰

Western aesthetic theories, in contrast, often prioritize the visual image as the fundamental basis of beauty. However, Paul Klee presents an alternative perspective that aligns with thinkers such as Koç and Atan. He famously states, "*Art does not reproduce the visible; rather, it makes visible.*" This notion closely parallels the principles of Islamic art and aesthetics, where beauty is not solely derived from outward form but also from invisible qualities that imbue an object with meaning and depth. ²¹The strength of Islamic aesthetics lies in its firm foundation—one that is deeply rooted in the pursuit of truth beyond the material realm.

GRANDEUR AS A MANIFESTATION OF ABSOLUTE BEAUTY AND SUBLIME

While delicacy, rounded forms, and soft lines often evoke a sense of refinement and elegance, an equally profound aesthetic experience arises from the encounter with grandeur, splendor, and sublimity. Such encounters elicit a sense of wonder and even reverence, deeply affecting the observer. Monumental works of art, such as the Süleymaniye Mosque, or awe-inspiring natural phenomena—towering mountains, vast oceans, and boundless skies—possess an inherent power that captivates the human spirit. These experiences provoke an aesthetic response that extends beyond admiration; they inspire awe and evoke a powerful emotional intensity that borders on the experience of the sublime. As Koç suggests, the sublime pushes the limits of human imagination, surpassing ordinary perception, and in such moments, one senses an encounter with the eternal.²²

¹⁹ Koç, *İslam*, 83.

²⁰ Ahmet Atan, *İslam Sanatında Özgünlük ve Evrensellik*, in *İslam, Sanat ve Estetik*, TDV VI. Religious Publications Congress Proceedings (İstanbul, 2013), pp.133-135.

²¹ Paul Klee in Atan, 135.

²² Koç, İslam, 90.



Al-Ghazālī provides an insightful distinction between beauty and grandeur by differentiating aesthetic beauty from intelligible beauty. He argues that sensory perception—sight, hearing, touch, and taste—allows one to experience only external beauty, whereas abstract beauty is grasped through *baṣīra bāțina* (inner sight). While outward beauty is accessible to all, including children and animals, the perception of inner beauty is an exclusive privilege of the human heart, illuminated by the light of inner vision. He further states, *"Inward vision is stronger than outward vision because the heart is more sensitive than the eye, and because the beauty of proportion or pure color is perceived by sight, but the beauty of majesty, grandeur, superiority, and all that is included in inner qualities is perceived by the sense of the heart."²³ In this assertion, Al-Ghazālī not only underscores the superiority of inward perception but also highlights grandeur as an essential component of this deeper aesthetic experience.*

Encounters with the sublime often induce a sense of insignificance, even helplessness, as one is confronted with overwhelming vastness and power. However, such experiences are paradoxically intertwined with immense pleasure. While a sense of humility arises in the presence of perfection, magnitude, or height, these very attributes transport the observer beyond the mundane, opening pathways to contemplation of the infinite. The echoes of the mountains, the falling of stars, or the celestial spectacle of the heavens—as referenced in the Qur'an—instill a deep awareness of an omnipotent Power. The aesthetic response to the sacred, therefore, merges beauty with reverence, creating an experience that unites awe, tranquility, and veneration. This convergence of emotions serves as a gateway to the sublime, transcending the physical realm and drawing the observer into existential contemplation.

The Qur'an frequently evokes this sense of the sublime, particularly in its descriptions of the Day of Judgment, as in the verse:

"Surely, what you are promised must come to pass. So when the stars are put out, and the sky is torn apart, and the mountains are blown away" (Al-Mursalat, 77:7–10).

This imagery, marked by cosmic upheaval, amplifies the profound aesthetic experience of sublimity, reinforcing the connection between grandeur, divine power, and artistic expression. The majesty of grand mosques exemplifies this aesthetic principle, evoking both awe and serenity. Nature, in its purest form, is a continuous exhibition of beauty, a testament to divine artistry. This perspective permeates Islamic artistic tradition, where the world itself is perceived as a manifestation of divine perfection. Ultimately, the experience of grandeur—whether encountered in nature, sacred architecture, or artistic expressions—serves as a reflection of absolute beauty, signaling the presence of the sublime. Within this framework, power, magnificence, and all forms of greatness are not merely aesthetic qualities but symbols of ultimate perfection and divine beauty.²⁴

CONCLUSION

The interwoven relationship between beauty, goodness, and truth in Islamic thought reveals that aesthetics cannot be divorced from ethical and metaphysical considerations. Unlike modern perspectives that often confine beauty to sensory pleasure or visual appeal, Islamic aesthetics is deeply embedded within an epistemological and moral framework.

²³ Abu Hamid Muhammed Ghazālī, *The Alchemy of Happiness*, trans. C. Field & E. Daniel (London, 1991), pp. 20, 156.

²⁴ Ghazālī, *The Alchemy*. 91.



The essence of beauty, as articulated by Al-Ghazālī and Ibn Sīnā, transcends mere physical appearance, residing in harmony, purpose, and ultimately, in its alignment with divine truth. Beauty, therefore, is not an autonomous entity but a manifestation of the sacred—a bridge between the material and the transcendent.

Through the exploration of the interrelatedness of beauty, goodness, and usefulness, it becomes evident that Islamic aesthetics does not perceive beauty as an isolated phenomenon. Rather, it is an extension of ethical principles, where aesthetic perfection is achieved through moral and intellectual refinement. This perspective stands in contrast to philosophical traditions that argue for the independence of aesthetics from ethics, as Islamic thought consistently underscores their intrinsic unity. The reflections of divine beauty in the natural and built environment—whether in the symmetry of Qur'anic verse, the proportionality of Islamic calligraphy, or the grandeur of sacred architecture—attest to an underlying order that governs both artistic expression and spiritual understanding.

The discussion on beauty as a reflection of knowledge and truth further underscores that Islamic aesthetics is not solely concerned with external form but with the capacity of beauty to signify deeper meanings. Art, in this tradition, is not a mere imitation of nature but an unveiling of metaphysical realities. The perspective that beauty serves as a conduit to truth is fundamental to the Islamic worldview, where artistic expression aligns with an intellectual and spiritual pursuit of knowledge. As noted by Ibn Arabī, beauty is not simply an attribute of creation but a direct reflection of divine essence, drawing the observer beyond the limits of perception into the realm of the infinite.

The notion of grandeur as a sign of absolute beauty and the sublime further reinforces the role of aesthetics in shaping the human experience of the sacred. The overwhelming sense of awe and humility elicited by monumental works—whether in the vastness of nature or the towering minarets of a mosque—demonstrates that beauty in Islamic thought extends beyond the realm of pleasure. It serves as a reminder of divine majesty, compelling the observer toward contemplation and submission. This experience of the sublime, where the boundaries of the self-dissolve before the immensity of creation, is not merely an aesthetic reaction but a deeply spiritual encounter.

Ultimately, the Islamic conceptualization of beauty is neither superficial nor arbitrary; it is an essential dimension of existence, intricately linked to morality, knowledge, and the divine. The triadic relationship between beauty, goodness, and truth underscores the unity of all things in the Islamic intellectual tradition, where aesthetics is not a domain of indulgence but a means of recognizing and affirming divine order. In a world where aesthetics is increasingly viewed through secular or consumerist lenses, the Islamic perspective offers a profound alternative—one that sees beauty not as an end in itself but as a path to the eternal.

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TRAINING IN APPLIED ART DESIGN WITH A FOCUS ON SUTAINABLE DEVELOPMENT

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Abstract

The Theory of Sustainable Development is a broad environmental issue that encompasses many fields and industries, particularly in the field of architectural construction. This article approaches the theory and selects objectives and criteria for sustainable development, seeking opportunities and possibilities for application in the training of interior architectural design and applied fine arts. As a result, it proposes some principles and standards for sustainable development in the practice of design and evaluation of sustainable design, thereby providing a foundation for the innovation of training programs in the design field, aiming at sustainable development values in the current university system in Vietnam

Keywords: Sustainable development, principles and standards of sustainable development, Interior architectural design, training



BIODEGRADABLE AND RECYCLABLE BUILDING MATERIALS: POTENTIAL AND CHALLENGES IN ARCHITECTURE INTERIOR DESIGN

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Abstract

In response to environmental challenges and the growing demand for sustainable development, the use of biodegradable and recycled building materials in interior architecture is gaining increasing recognition. These materials not only help minimize negative impacts on ecosystems but also contribute to improving the quality of living spaces, creating a healthier and safer environment. This paper delves into the potential of biodegradable and recycled materials in interior design while identifying technical, economic, and policy-related obstacles in their practical implementation. Additionally, the paper proposes practical solutions to encourage and expand the application of environmentally friendly materials, contributing to shaping a sustainable, efficient interior architecture industry that aligns with future green development trends.

Keywords: sustainable construction, eco-friendly architecture AI, furniture design, child development, adolescent idiopathic scoliosis (AIS)

1. Introduction

In recent years, the integration of biodegradable and recyclable materials in architecture and interior design has gained significant attention as an essential strategy for reducing environmental impact. As concerns about climate change and resource depletion continue to escalate, the construction and design industries are being urged to adopt more sustainable approaches that align with ecological conservation and long-term environmental responsibility (Crane, 2008; Dennis, 2010). The built environment plays a crucial role in shaping sustainability efforts, as traditional construction practices often contribute to excessive waste generation, carbon emissions, and resource exploitation. By incorporating biodegradable materials, which naturally decompose without leaving harmful residues, and recyclable materials, which can be repurposed to extend their lifecycle, architects and designers can actively contribute to a more circular economy. This approach not only minimizes the environmental footprint of buildings but also fosters a more responsible use of raw materials while promoting innovative design solutions (De Corato, 2021; Sassi, 2006).

Moreover, beyond their ecological advantages, biodegradable and recyclable materials offer significant potential in enhancing both the aesthetic and functional quality of interior spaces. Advances in material technology have led to the development of sustainable alternatives that do not compromise durability, structural integrity, or visual appeal. As such, integrating these materials into architectural and interior design practices is not merely an environmental obligation but also an opportunity to explore new creative possibilities that harmonize sustainability with beauty and functionality. Given the increasing urgency of climate change and the global push toward environmental accountability, it is imperative for architects, designers, and industry stakeholders to actively seek and implement innovative material solutions. Emphasizing biodegradable and recyclable materials within the context of circular economy principles can lead to a more resilient and adaptable built environment—one that meets both contemporary needs and the long-term sustainability goals of future generations.



2. The Potential of Biodegradable and Recyclable Materials2.1. Biodegradable Materials in Interior Architecture

The use of biodegradable materials in interior architecture has gained increasing attention due to their potential to reduce environmental impact while maintaining aesthetic and functional standards. These materials, which naturally break down over time without leaving harmful residues, align with the principles of sustainable design and contribute to the development of eco-friendly built environments. Among the most widely researched biodegradable materials are bamboo, mycelium-based composites, and agricultural waste derivatives, each offering unique advantages in terms of sustainability, durability, and adaptability in interior applications (Vân, 2018; Hoàng et al., 2023). Bamboo, for instance, is a rapidly renewable resource that possesses high strength-to-weight ratio, making it an ideal alternative to traditional wood-based materials. Its natural antibacterial properties, flexibility, and aesthetic versatility allow it to be used in various interior elements, including flooring, wall paneling, furniture, and decorative features. Additionally, bamboo's ability to sequester carbon throughout its growth cycle makes it a key player in reducing the overall carbon footprint of construction projects. Another innovative biodegradable material is mycelium-based composites, derived from fungal networks that bind organic matter into durable, lightweight structures. Mycelium-based materials have been increasingly explored as sustainable alternatives for interior applications such as acoustic panels, furniture, and even partition walls. Due to their natural insulating properties, they contribute to improved indoor air quality while offering a unique, organic aesthetic that complements biophilic design approaches. Furthermore, these composites require minimal energy and resources for production, reinforcing their status as a low-impact, sustainable option for interior architecture (Armstrong, 2023).

In addition to bamboo and mycelium, agricultural waste derivatives such as rice husk panels, coconut coir, and wheat straw boards present viable solutions for eco-conscious interior design. These materials, often upcycled from byproducts of agricultural production, not only reduce waste but also enhance the circular economy by giving new life to discarded natural fibers. Studies have highlighted their effectiveness in improving indoor air quality by minimizing volatile organic compound (VOC) emissions, making them particularly beneficial for health-conscious interior spaces (Rashdan & Ashour, 2024). The integration of biodegradable materials in interior architecture represents a significant step toward sustainable design practices. As research and technological advancements continue to enhance the performance and availability of these materials, their adoption in mainstream construction and interior design is expected to grow. By prioritizing the use of renewable, naturally decomposing materials, architects and designers can actively contribute to a more environmentally responsible built environment while simultaneously improving occupant well-being and overall indoor environmental quality.

2.2. Recyclable Materials and Their Advantages

The integration of recyclable materials in interior architecture and construction plays a crucial role in promoting sustainability by reducing waste, conserving natural resources, and minimizing the environmental footprint of buildings. As concerns about resource depletion and excessive waste generation continue to grow, architects and designers are increasingly turning to recyclable materials as viable alternatives to conventional, high-impact building materials. Recyclable materials such as repurposed wood, glass, and plastics are now considered fundamental components of contemporary green architecture due to their ability to enhance resource efficiency and support a circular economy (Vefago & Avellaneda, 2013). One of the most widely used recyclable materials in interior design is repurposed wood, which can be sourced from demolished buildings, old furniture, or industrial pallets. **ASIA PACIFIC** 11th INTERNATIONAL CONGRESS ON CONTEMPORARY SCIENTIFIC RESEARCH March 12-15, 2025 / Ho Chi Minh, Vietnam WEB: https://www.iksadasia.org/ E-MAIL: iksadasia@gmail.com

Reclaimed wood offers a unique aesthetic appeal, often featuring weathered textures and rich patinas that add character to interior spaces. Beyond its visual advantages, repurposed wood reduces the demand for virgin timber, thereby decreasing deforestation rates and lowering carbon emissions associated with the production and transportation of new wood materials. Additionally, reclaimed wood is highly versatile and can be used for flooring, wall cladding, furniture, and decorative elements, making it an ideal material for both traditional and modern interiors (Hebel et al., 2014).

Recycled glass is another valuable material in sustainable interior design, offering both environmental and aesthetic benefits. Glass is infinitely recyclable, meaning it can be reused multiple times without losing its quality or integrity. When repurposed, it can be transformed into countertops, tiles, partitions, and decorative panels. One of the key advantages of recycled glass is its ability to reduce the energy required for glass production, as melting recycled glass consumes significantly less energy compared to manufacturing new glass from raw materials. Additionally, glass is non-toxic, does not emit volatile organic compounds (VOCs), and enhances indoor lighting by reflecting and diffusing natural light, thereby contributing to improved energy efficiency in buildings (Rashdan & Ashour, 2017).

Recycled plastics have also emerged as innovative solutions in sustainable architecture, addressing the growing issue of plastic waste pollution. Advances in material science have enabled the transformation of post-consumer and post-industrial plastic waste into durable and high-performance building materials. Recycled plastics can be molded into various forms, including composite panels, 3D-printed furniture, and even structural components for modular construction. By diverting plastic waste from landfills and oceans, these materials contribute to waste reduction while offering lightweight, moisture-resistant, and low-maintenance solutions for interior applications. Additionally, recycled plastic materials can be engineered to mimic the appearance of wood, stone, or other natural materials, providing a cost-effective and eco-friendly alternative to non-renewable resources.

The use of recyclable materials in interior architecture aligns with global sustainability goals by promoting waste reduction, lowering carbon footprints, and enhancing material circularity. Incorporating these materials not only helps minimize environmental degradation but also encourages innovative design approaches that balance aesthetics with ecological responsibility. As advancements in recycling technologies continue to expand the range of available materials, architects and designers have greater opportunities to integrate sustainability into their projects without compromising quality, functionality, or visual appeal. By prioritizing the use of repurposed and recyclable materials, the built environment can move closer to achieving long-term sustainability while fostering a more responsible approach to material consumption and waste management.

3. Challenges in Implementing Sustainable Materials

While the integration of biodegradable and recyclable materials in architecture and interior design presents significant environmental benefits, their widespread adoption faces several challenges. These challenges stem from technical limitations, economic constraints, and policy-related barriers, which collectively slow down the transition toward more sustainable building practices. Addressing these obstacles requires a comprehensive approach that involves technological innovation, economic incentives, and regulatory support to ensure that sustainable materials become viable and practical alternatives in the construction and interior design industries.



3.1. Technical Challenges

One of the primary concerns associated with biodegradable and recyclable materials is their durability and structural integrity, especially in high-traffic interior environments where materials are subject to continuous wear and tear. Unlike conventional materials such as concrete, steel, and synthetic composites, some biodegradable materials—such as mycelium-based composites, bamboo, and agricultural waste derivatives—may have limited resistance to moisture, fire, and physical impact. This can lead to shorter lifespans, increased maintenance costs, and performance inconsistencies, which deter their adoption in large-scale projects (Abyzov et al., 2020; De Luca et al., 2017). Additionally, compatibility with existing construction methods poses another significant technical barrier. Many sustainable materials require specialized installation techniques, adhesives, or coatings to enhance their longevity and performance.

However, a lack of standardized manufacturing processes means that their quality and properties can vary significantly between suppliers. Without consistent material standards, architects and designers may struggle to integrate biodegradable and recyclable materials seamlessly into their projects, particularly when retrofitting existing buildings or combining them with conventional materials. Furthermore, recyclable materials, particularly plastics and composites, can degrade in quality after multiple recycling cycles, affecting their structural performance and aesthetic appeal. The challenge of ensuring high-quality recyclability, along with the limitations of current recycling technologies, creates uncertainty regarding the long-term viability of these materials in interior applications.

3.2. Economic Constraints

The cost of sustainable materials remains one of the most significant barriers to their widespread implementation. Many biodegradable and recyclable materials are still in the early stages of commercial production, leading to high manufacturing costs due to limited economies of scale. The expense of sourcing, processing, and transporting these materials is often greater than that of conventional materials, making them less accessible to architects, designers, and construction firms with budget constraints (Ahmadizadeh et al., 2024; Hayles, 2015). Additionally, the limited availability of sustainable materials in mainstream markets further exacerbates the issue. While demand for eco-friendly materials is growing, production capacities remain insufficient to meet industry needs at a competitive price. This is particularly evident in regions where supply chains for biodegradable and recyclable materials are underdeveloped, leading to higher costs associated with importing materials from specialized manufacturers.

Another economic hurdle is the perceived lack of return on investment (ROI) for clients and developers. Since biodegradable and recyclable materials often require additional maintenance, protective treatments, or replacements over time, some stakeholders may hesitate to invest in them, prioritizing short-term cost savings over long-term environmental benefits. Without clear financial incentives, many decision-makers opt for conventional materials that offer immediate cost-effectiveness despite their negative environmental impact.

3.3. Policy and Regulation Issues

A major policy-related challenge is the lack of standardized regulations and certifications for biodegradable and recyclable materials. Unlike traditional construction materials, which undergo rigorous testing and standardization processes, many sustainable alternatives lack universally accepted quality benchmarks. This regulatory gap makes it difficult for architects and designers to assess the reliability and safety of these materials, leading to hesitancy in their adoption (Honrao, n.d.; Umoh et al., 2024).



Moreover, governmental incentives for sustainable material usage remain insufficient in many countries, further restricting their implementation. While some governments have introduced green building codes, tax incentives, and certification programs (such as LEED and BREEAM) to encourage the use of eco-friendly materials, these policies are not always comprehensive or widely enforced. In regions where sustainability policies are weak or inconsistent, developers may lack motivation to transition away from conventional materials that are more readily available and cost-effective. Additionally, waste management infrastructure for recyclable materials is often inadequate, limiting the efficiency of recycling programs and circular economy initiatives. Many cities and municipalities lack the necessary facilities to properly process and repurpose construction waste, resulting in recyclable materials being discarded rather than reintegrated into new building projects. Without stronger regulatory frameworks and investments in recycling infrastructure, the full potential of recyclable materials cannot be realized.

3.4. Overcoming These Challenges

To overcome these barriers, a multi-faceted approach involving technological advancements, financial incentives, and regulatory improvements is necessary:

Enhancing material durability through innovative treatments and hybrid material combinations can improve the structural integrity of biodegradable materials, making them more viable for long-term use in interior applications. Expanding research and development in sustainable material science can help reduce production costs and improve market competitiveness, making eco-friendly materials more accessible. Government support through subsidies, tax breaks, and stricter environmental regulations can incentivize developers and businesses to integrate biodegradable and recyclable materials into their projects.

Investment in waste management and recycling infrastructure can increase the efficiency of material recovery processes, ensuring that recyclable materials are properly reintegrated into the supply chain rather than discarded. Public awareness campaigns and industry collaborations can help shift perceptions about sustainable materials, highlighting their long-term economic and environmental benefits. By addressing these challenges with strategic interventions, biodegradable and recyclable materials can become more practical and desirable options in interior architecture, ultimately contributing to a more sustainable built environment.

4. Strategies for Enhancing Sustainable Material Usage

4.1. Advancing Material Research and Development

The advancement of biodegradable and recyclable materials in interior architecture largely depends on continued investment in research and development (R&D). Exploring innovative biobased and recycled materials can significantly enhance their structural performance, durability, and affordability, making them more viable alternatives to conventional construction materials (Almusaed et al., 2023; Uyên, n.d.). However, achieving widespread adoption requires a multidisciplinary approach, involving collaboration between academia, industry, and policymakers to bridge the gap between laboratory research and real-world applications.

4.1.1. Innovations in Biodegradable Materials

Recent advancements in biodegradable materials have demonstrated the potential of organicbased substances such as mycelium composites, algae-derived bioplastics, hempcrete, and agricultural waste derivatives in interior applications. These materials offer low carbon footprints, excellent thermal insulation properties, and improved indoor air quality, making them ideal for sustainable architecture.



However, further research is needed to enhance their moisture resistance, load-bearing capacity, and fire resistance, ensuring they meet building code requirements and safety standards. For instance, bioengineered mycelium composites are gaining attention due to their lightweight, mold-resistant, and self-growing properties. While promising, their widespread use is still limited due to concerns about scalability, production efficiency, and long-term durability. Investments in material engineering and nanotechnology could help enhance their mechanical properties and make them more competitive in the market.

Similarly, bio-based plastics and resins derived from corn starch, algae, and cellulose are emerging as sustainable alternatives to traditional synthetic polymers. These materials can be biodegradable or compostable, reducing reliance on petroleum-based plastics. However, their susceptibility to degradation under high humidity and temperature conditions remains a challenge, necessitating further refinement in material stabilization techniques.

4.1.2. Advancements in Recycled Materials

Recyclable materials, such as repurposed wood, reclaimed glass, and recycled metals and plastics, are playing a pivotal role in circular economy models for the built environment. Innovations in recycling technologies and upcycling techniques have improved the strength, durability, and aesthetic versatility of these materials, making them suitable for high-end interior applications. For example, reclaimed wood can be processed using advanced thermal and chemical treatments to enhance its durability, making it more resistant to moisture and pests. Additionally, engineered wood products, such as cross-laminated timber (CLT) and reclaimed plywood, are being developed to provide stronger, more sustainable alternatives to conventional hardwoods. Recycled plastics, particularly high-density polyethylene (HDPE) and polyethylene terephthalate (PET), have shown potential in furniture design and decorative paneling. Advances in plastic remanufacturing have led to the development of composite materials that combine recycled plastics with natural fibers, improving their mechanical strength and aesthetic appeal. However, the degradation of plastics over multiple recycling cycles remains a challenge, highlighting the need for continued innovation in chemical recycling and polymer stabilization technologies.

4.1.3. The Role of Academia, Industry, and Policymakers in Material Innovation

A successful transition toward sustainable materials requires strong collaboration among universities, private-sector industries, and government agencies. Academic institutions play a critical role in fundamental research and material testing, exploring new bio-based and recyclable materials while developing methods to enhance their performance. Research partnerships between universities and private enterprises can help accelerate technology transfer from laboratories to commercial markets. Industry stakeholders, including construction companies, interior design firms, and material manufacturers, are key players in scaling up material production, optimizing supply chains, and integrating sustainable materials into mainstream architectural practices. Companies investing in sustainable product development and eco-friendly manufacturing processes can help drive market demand.

Government policies and incentives can significantly influence the adoption of sustainable materials. Supportive measures such as research grants, tax incentives, and material certification programs can encourage businesses to invest in green innovations. Additionally, the implementation of mandatory green building standards and material performance regulations can help create a more structured and competitive market for sustainable materials.

4.1.4. Future Prospects and Investment Strategies

To ensure the continued advancement of biodegradable and recyclable materials, targeted investments should focus on:



- Enhancing Research Funding: Increasing financial support for R&D initiatives in sustainable material science, particularly in areas such as biomimicry, nanotechnology, and circular material design.

- Expanding Pilot Projects: Encouraging large-scale implementation of sustainable materials in public and private construction projects to demonstrate their feasibility and performance.

- Developing Material Certification Systems: Establishing standardized testing protocols and eco-labeling schemes to ensure consistency in the quality and reliability of biodegradable and recyclable materials.

- Strengthening Industry Partnerships: Facilitating cross-sector collaborations between architects, designers, engineers, and material scientists to accelerate the commercialization of innovative materials.

By prioritizing material research and development, alongside stronger industry and policy support, biodegradable and recyclable materials can become integral components of the future of sustainable interior architecture.

4.2. Policy Interventions and Market Incentives

The successful adoption of biodegradable and recyclable materials in architecture and interior design is not solely dependent on technological advancements; it also requires comprehensive policy interventions and market-driven incentives. Governments and regulatory bodies play a pivotal role in shaping industry practices by implementing policies, financial incentives, and awareness campaigns that encourage the use of sustainable materials (Rybak-Niedziółka et al., 2023). A well-structured regulatory framework, coupled with strong market incentives, can accelerate the transition toward an environmentally responsible construction sector.

4.2.1. Government Policies and Regulations

To foster the integration of sustainable materials, governments must establish clear policies and enforceable regulations that promote the use of biodegradable and recyclable materials in architectural and interior design projects. Key policy measures include:

- Mandatory Green Building Standards: Governments can mandate the inclusion of biodegradable and recyclable materials in construction projects by revising building codes and sustainability certification requirements. For example, programs such as LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), and EDGE (Excellence in Design for Greater Efficiencies) encourage sustainable practices by providing certification based on material efficiency, energy conservation, and waste reduction.

- Material-Specific Regulations: Developing performance standards and durability guidelines for biodegradable and recycled materials ensures their safety and effectiveness in interior applications. Regulatory agencies can implement eco-labeling programs to certify materials that meet environmental and health safety benchmarks.

- Waste Management and Circular Economy Laws: Legislation that supports waste reduction, extended producer responsibility (EPR), and closed-loop recycling systems can significantly impact material availability. Governments can introduce mandatory recycling targets and restrictions on non-recyclable materials to encourage circular design principles.

4.2.2. Financial Incentives and Subsidies

The adoption of sustainable materials often faces economic barriers, such as higher production costs, limited supply chains, and market competition with conventional materials.



To overcome these obstacles, policymakers can introduce financial incentives that make biodegradable and recyclable materials more economically viable:

- Tax Incentives for Green Materials: Offering tax credits, VAT reductions, or import duty exemptions on sustainable materials can lower costs and encourage widespread adoption. For example, businesses that invest in eco-friendly material production, research, and development could benefit from corporate tax deductions.

- Subsidies for Sustainable Construction: Government grants and subsidies can support construction projects that prioritize biodegradable and recyclable materials, particularly in public infrastructure, housing projects, and commercial developments.

- Low-Interest Loans and Green Bonds: Financial institutions, in collaboration with governments, can offer green financing options such as low-interest loans and sustainability-linked bonds to developers, manufacturers, and architects committed to using environmentally friendly materials.

4.2.3. Market-Based Incentives and Private Sector Involvement

In addition to government interventions, market-driven strategies can stimulate the demand for sustainable materials. The private sector plays a crucial role in innovating, promoting, and integrating eco-friendly materials into mainstream design practices. Some key strategies include:

- Corporate Sustainability Programs: Companies involved in construction and interior design can implement corporate social responsibility (CSR) initiatives that prioritize sustainable materials, reducing their carbon footprint and gaining competitive advantages.

- Sustainability Certifications for Products and Businesses: Consumers and businesses are more likely to choose materials that carry third-party environmental certifications such as Cradle to Cradle, FSC (Forest Stewardship Council), and Global GreenTag. Governments can collaborate with certification bodies to ensure transparency and consumer trust in sustainable material markets.

- Public-Private Partnerships (PPPs): Collaborative efforts between government agencies, research institutions, and private enterprises can enhance material research, streamline production processes, and improve distribution networks for biodegradable and recyclable materials.

4.2.4. Awareness Campaigns and Educational Initiatives

Despite advancements in sustainable material science, awareness and knowledge gaps among architects, designers, manufacturers, and consumers remain a barrier to widespread adoption. To address this issue, governments and industry stakeholders can implement educational programs and awareness campaigns focused on:

- Training and Certification Programs: Developing professional training courses in ecofriendly material selection, sustainable interior design, and circular economy practices for architects and designers.

- Consumer Awareness Campaigns: Governments can launch public information campaigns to educate homeowners, businesses, and developers about the environmental and economic benefits of using biodegradable and recyclable materials.

- University and Research Collaborations: Encouraging partnerships between universities and the private sector to integrate sustainability-focused courses and research projects into architecture and design curricula.

4.2.5. The Future of Policy and Market Interventions

To ensure the long-term viability and mainstream adoption of biodegradable and recyclable materials, policymakers and industry leaders must work toward:

- Developing Integrated Policy Frameworks: Establishing cross-sectoral policies that connect sustainable materials with waste management, climate action, and construction regulations.

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- Enhancing Public and Private Investment: Increasing funding for material research, sustainable manufacturing, and infrastructure development related to eco-friendly materials.

- Promoting International Collaboration: Encouraging global knowledge exchange and best practice sharing through participation in international sustainability initiatives and agreements such as the Paris Agreement and the United Nations Sustainable Development Goals (SDGs).

By implementing robust policy measures, financial incentives, and market-driven initiatives, governments and businesses can create a sustainable ecosystem that supports the growth of biodegradable and recyclable materials, ultimately reducing environmental impact and promoting a circular economy in architecture and interior design.

5. Conclusion

The integration of biodegradable and recyclable materials in interior architecture represents a transformative approach toward achieving sustainability and environmental responsibility. These materials not only minimize ecological footprints by reducing waste and carbon emissions but also contribute to healthier indoor environments through improved air quality and resource efficiency. As the demand for sustainable design grows, the importance of adopting circular economy principles and advancing material innovation becomes even more crucial. However, despite their undeniable benefits, the widespread adoption of biodegradable and recyclable materials still faces numerous technical, economic, and regulatory challenges. Issues related to material durability, structural integrity, and production scalability must be addressed to ensure their effective application in high-traffic and long-term interior environments. Additionally, financial constraints and market accessibility remain significant barriers, as the cost of developing and implementing these sustainable materials is often higher than conventional alternatives. Moreover, gaps in policy frameworks, lack of standardization, and insufficient governmental incentives further hinder large-scale adoption.

To overcome these challenges, a multifaceted approach is necessary. Future research should focus on enhancing material performance, ensuring that biodegradable and recyclable materials not only meet but exceed conventional material standards in terms of strength, longevity, and versatility. Collaboration between scientists, designers, architects, and engineers will be vital in exploring new bio-based composites, nanotechnology-enhanced recyclables, and hybrid material solutions that maximize efficiency and sustainability. Moreover, policy interventions must be strengthened to create a supportive regulatory environment that encourages sustainable material use. Governments and international organizations should implement mandatory green building regulations, tax incentives, certification programs, and subsidies to accelerate the transition toward sustainable construction and interior design. Increased investment in green research and development, publicprivate partnerships, and sustainable supply chain management will further drive innovation and accessibility in the market. Beyond technical and policy-driven solutions, education and awareness initiatives must be expanded to inform architects, designers, manufacturers, and consumers about the benefits and feasibility of biodegradable and recyclable materials. By fostering a culture of sustainability through professional training, university curricula integration, and public awareness campaigns, the industry can ensure a long-term shift toward environmentally responsible design practices. In conclusion, while biodegradable and recyclable materials hold immense potential in revolutionizing sustainable interior design, their success depends on overcoming existing barriers through technological advancements, economic incentives, policy support, and educational initiatives. By investing in innovative material development, regulatory reforms, and market-driven sustainability strategies, stakeholders can collectively create a resilient, resource-efficient, and environmentally friendly built environment for future generations.



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THE ROLE OF VISUAL ARTS IN HUE'S ROYAL ARCHITECTURE

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Abstract

The Visual Arts in the Architecture of the Hue's Royal throughout the Nguyen Dynasty represent a crucial component of the Hue Monuments Complex, contributing significantly in various aspects. Beyond being a decorative element found in numerous architectural structures, visual arts manifest through a diverse range of themes, rich in aesthetic, cultural, and historical values. This study examines the characteristics of visual arts by analyzing color, form, and techniques expressed on the exterior of selected imperial structures. It also emphasizes the necessity of recognizing and preserving the artistic values embedded in architecture. At the same time, many architectural heritage sites in Hue are currently at risk of deterioration and disappearance due to urbanization and socio-economic development. Through field research and the application of new methodologies and theoretical approaches, this study evaluates the impact of these processes on visual arts. Furthermore, it proposes directions for the conservation and sustainable development of artistic elements in the future. **Keywords:** Visual arts, aesthetics, Hue royal architecture, heritage.



INTEGRATION OF AI IN BATHROOM DESIGN: TOWARDS CONVENIENCE AND UNIVERSAL DESIGN

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Abstract

Artificial intelligence (AI) applied in bathroom design is generating ground-breaking ideas stressing comfort, security, and utility for all purposes. From smart water temperature control and auto-sensing technology to AI-powered toilets, these solutions improve the user experience and also maximize resource and energy efficiency. In the bathroom, universal design calls for the incorporation of sustainability and technology to produce an environment fit for everyone - including the disabled and elderly. AI helps tailor the experience, predict maintenance needs, and optimize space to make the bathroom a part of the smart home network. All of this is not only a trend but also a future move in pursuit of seeing universal design take even more ground.

Keywords: artificial intelligence (AI), ergonomic, bathroom design, universal design, interior, technology, smart home

1. Introduction

The rapid development of artificial intelligence (AI) technology has changed many aspects of life, including interior design. AI has been integrated through generative design algorithms, virtual reality tools, and machine learning algorithms. This can help architects optimize projects for energy efficiency (Almaz, A. F. et al., 2024). Research by (Ashour, A. F. & Rashdan, W., 2023) has shown that integrating smart solutions into interior design is not only a trend but also an effective method, helping to enhance the aesthetics and improve the usability of the space. In recent years, the integration of AI into bathroom design has brought about many significant improvements, not only enhancing the user experience but also optimizing the efficiency of space and resources.

A study by (Aminzadeh, F. et al., 2000) of 550 elderly residents in non-profit apartment buildings in Canada found that 32% had fallen before the study. It can be seen that the rate of slipping is not low in the bathroom. Conventional designs that do not care about functionality are no longer enough to meet the needs of users. Changing the floor material seems to be insufficient when considering some groups of people who need attention such as the elderly, women, and children. Smart bathroom design today not only focuses on convenience but also aims to serve all users, including the elderly and people with disabilities, through the application of universal design principles. The reason is that in the context of population aging becoming a global issue, many countries are facing particularly serious challenges such as a large and rapidly growing elderly population (Bian, C. J. et al., 2024; Afifi, M. et al., 2015; Gleisner, A. S. et al., 2022). Rapid economic development and the busy lifestyles of young people have led to the need for independent living of both young people and the elderly. As a result, more and more elderly people are living alone. Meanwhile, for the elderly, the bathroom is an area that needs special attention in design to address individual needs (Bian, C. J. & Choi, K. R., 2024).



In addition, people with disabilities may have trouble using the bathroom because they are in a wheelchair. While home care workers and therapists consider the bathroom to be a particularly difficult environment (King, E. C., et al., 2016).

The main issue in smart home design is health care (Park, N.-C. et al., 2006). However, health care in the bathroom by conventional measures seems to be very difficult. Therefore, many studies have been tested to integrate the Internet of Things (IoT) into the bathroom (Dan, D. Koo, et al., 2016; Abdulrazak, B., et al., 2023; Purwanto, A. J., 2019). This proves that the integration of smart home technology to support the health of users in the technology era is a matter of great concern and will be a new development direction for the field of interior design.

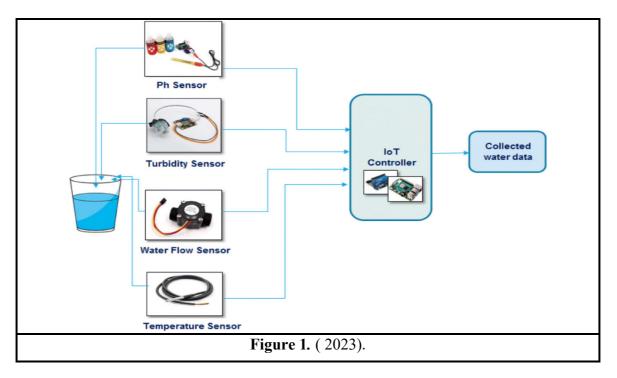
This article aims to analyze the role of AI in improving bathroom design, including water temperature control, sensor technology, and smart toilet devices. It also discusses the benefits of AI in personalizing the experience, predicting maintenance needs, and increasing energy efficiency.

2. Artificial intelligence and bathroom design

2.1. Smart water temperature control system

Smart water temperature control systems use AI to adjust water temperature according to user needs and habits. AI is capable of learning from daily usage behaviors to set the ideal water temperature, helping to save energy and increase comfort.

Water is an important resource for the environment and human health. Accurate water quality prediction helps improve global water management and safety. The paper (Ezz El-Din Hemdan et al., 2023) introduces a water quality monitoring system based on IoT and machine learning, which enables large-scale water quality prediction to support effective decision-making. If this system can integrate water temperature management technology, it can optimize water use in smart bathrooms and domestic water systems.





Integrating AI to control water temperature can also solve the difficulties of couples when bathing their children. Research (Zahorulko, A., 2021) has developed a system that uses a microcontroller to monitor the temperature and water level in the bathtub, making bathing safe and saving resources. The system has been added with a temperature sensor combined with LED lights that signal the water temperature by color, displaying information on a mobile application, making it easier to control the bathing process. This is a typical example of the features that AI can integrate from technology into smart homes for future life.

2.2. Automatic sensor technology

Automatic sensor technology allows the presence of a user to be detected to activate devices such as faucets, lights, and ventilation systems. AI can analyze data from sensors to adjust light intensity, air temperature, and water pressure, creating the most suitable environment for users. Sensors and software can be used to automatically create spaces that interact with people or body-shaped objects in meaningful ways without direct contact.

In addition to the ability to light up, smart lighting systems can integrate into health care routines by using circadian lighting to regulate sleep and mood. The bathroom not only meets functional needs but also becomes a personalized space, promoting relaxation and improving health. With the development of smart lighting technology, the bathroom of the future is expected to be increasingly flexible, adjusting the light according to both the actual needs and the emotional state of the user.

Not only that, sensor technology is also focused on investing more in bathtubs. Smart bathtubs integrate monitoring sensors and artificial intelligence to not only clean the body but also create a relaxing space with gentle music. Sensors measure sympathetic and parasympathetic nerve states, while AI adjusts the optimal atmosphere for the user.

2.3. Smart toilets integrated with AI

Smart toilets use AI to detect the user's personal needs, including automatically adjusting the temperature of the toilet lid, adjusting the water pressure when flushing, and automatically cleaning. Or AI technologies that integrate voice control, automatically open the lid thanks to sensors that detect users approaching, and foot sensors that help open the seat rim without touching. Some advanced AI systems are also capable of analyzing the user's health through parameters in urine or feces. This is something to look forward to in the coming decades. There has been research by (Zsuzsa Millei & Jannelle Gallagher, 2011) showing that the bathroom space is less concerned as part of the environment in the early years of a child's life. Bathroom practices in childcare facilities are often considered from a medical and developmental perspective, such as pathologies related to urination and defecation.

In addition, maintaining bathroom and toilet hygiene is an important factor in preventing pathogenic bacteria and viruses. Many infectious diseases such as salmonella, E. coli, and staphylococcus originate from unsanitary environments and unscientific living habits (Jaglarz, A., 2020). Therefore, if there is an AI-integrated system to maintain cleanliness, this will create a more comfortable and easier living environment for everyone, including the elderly and people with disabilities.

3. Universal design in smart bathrooms

3.1. Universal design ensures accessibility and usability for everyone.

Inclusive design in smart bathrooms is about creating spaces that are accessible and easy to use for everyone, including the elderly and people with disabilities.



AI systems can customize the height of sinks, and shower chairs, or automatically adjust the height of mirrors to suit the user. In addition, devices such as smart showers and bathtubs can be programmed to provide bathing modes that suit individual preferences and needs, from adjusting water temperature to water pressure. This not only helps create a relaxing space but also helps minimize the risks associated with manually adjusting devices.

In addition, the connection between devices in smart bathrooms can help users easily control them via phone applications or voice. This not only brings convenience but also helps users control bathroom features without moving too much, which is especially useful for the elderly or those with limited mobility.

In addition, the study by (Feifei Chen, 2022) applies artificial intelligence to bathroom product design, proposing an innovative model to optimize user experience. By analyzing user characteristics and building an auxiliary design framework, the study helps improve interaction performance and reduce false responses. The experimental results show that this method improves efficiency and optimizes time in a smart bathroom environment. This AI technology can be integrated to integrate the needs of a household, especially for households with individuals who need care and attention.

3.2. Predictive and smart maintenance

AI is capable of collecting and analyzing data from bathroom devices to predict maintenance issues before they occur. For example, AI can detect signs of water leaks or water heater performance degradation and notify users to perform timely maintenance.

In addition, AI can combine with air quality sensors to monitor humidity and detect mold or harmful bacteria, thereby providing warnings and suggesting measures to improve the environment.

4. Sustainability and resource optimization

AI helps optimize energy and water usage by analyzing usage data and making recommendations to reduce waste. AI systems can automatically adjust water flow and light power according to actual needs, helping to reduce operating costs and protect the environment.

There are about 40 million people in the world with Alzheimer's, mostly over 65 years old. Dementia can make them forget to turn off the faucet, causing unexpected flooding (Wu Dijing, 2019). Having an AI system that can automatically turn off the faucet after a period of 15 to 30 minutes of non-use for people with Alzheimer's disease may be one of the necessities in the future. This helps to limit the waste of resources, especially clean water - one of the resources that needs to be used reasonably due to the current environmental pollution problem.

Research by (Ripo Winda Kusuma et al., 2024) has presented an application of an automatic sensor system designed using Arduino Uno and a passive infrared (PIR) sensor to control lights in the bathroom. This system detects infrared radiation from the human body, determines the presence in the room, and automatically turns on/off the lights to optimize energy use. The goal is to reduce electricity waste due to inefficient usage habits. This system could be one of the suitable technologies to integrate into AI.





5. Conclusion

The AI application is the next level of enhancements in both operational capability and ecofriendly design of spaces in a building when applied in the design of the bathrooms. Smart bathrooms may serve the needs of elderly and disabled persons with ease and convenience through the advanced use of technologies User experience is complimented by increased safety comfort and ease of movement within the spaces achieved through smart water temperature control automatic sensors, and intelligent toilet systems.

The efficiency of the AI system greatly improves the efficiency of predictive maintenance of restroom systems service. This, in turn, gives an alert about repair needs and about how the system is performing in service to aid its efficiency and longevity for the end-user. Marrying smart systems with AI-aided universal design approaches breaks barriers toward the direction of supporting everyone in smart bathrooms and empowering and addressing different needs. The integration of AI into bathroom design is not only as a new technology trend but more importantly as an important step in the trend towards universal and sustainable design.

With the advancement of AI, its application to the design of bathrooms is bound to get more complex, changing ordinary spaces into smart, responsive ones. Further improvements are expected to come from future explorations in this field and in provide answers that correspond to user discomfort and global sustainability issues. The bathrooms of the future won't just serve hygiene and relaxation purposes, but will also set an example of smart, inclusive, and eco-friendly efficiency, showcasing how AI can improve lives.

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LIFE CYCLE ASSESSMENTS (LCA) AND LIFE CYCLE COSTING (LCC) OF STRUCTURAL SYSTEMS

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ABSTRACT

The life cycle management approach consists of two main frameworks Life Cycle Assessment (LCA) and Life Cycle Cost (LCC) Assessment. LCA is an assessment method that analyzes the environmental impacts of a product or process using scientific methods throughout its life cycle, from raw materials to disposal. LCC provides the identification and quantification of all costs of a building's life cycle and aims to optimize the cost of the structure throughout its life cycle. Structural elements constitute the largest percentage of the total building materials and have a greater environmental impact than most other building elements, such as cladding, flooring, and roofing. The decision regarding a building's structural frame selection therefore has a major impact on the building's environmental impact and life cycle costing. In this respect in this study, it is the purpose to explain and to analyze structural systems in terms of life cycle environmental impacts and life cycle costings. First of all, LCA and LCC are explained systematically in line with the literature. LCA and LCC analyses are performed using GaBi software. The reinforced concrete framed building is handled which is important for Türkiye's building stock for analysis. Evaluations are made in line with the findings obtained. The importance of optimum life cycle performance in the selection of the structural system is stated.

Keywords: Life Cycle Assessment (LCA), Life Cycle Costing (LCC), Structural Systems.

INTRODUCTION

Life cycle management is an approach to strategically managing a product or system throughout its lifespan, and Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) are the two main frameworks of this approach. The life cycle approach aims to optimize sustainability, efficiency, and environmental impacts. LCA is an environmental management tool that systematically and holistically evaluates and analyzes a product's or process's environmental impacts based on the energy and resources that they require throughout their lifespan. The construction industry is responsible for a significant amount of energy demand globally. At the same time, it causes a significant impact on the environment because of environmental emissions. Building energy consumption and associated emissions have a great impact on the environment (Xing et al., 2008). In this respect, the construction industry has enormous potential to minimize its carbon footprint, and the environmental performance of a building throughout its lifespan is an important issue. The environmental impact is mainly related to resource consumption and emissions. In this respect, energy consumption is a widely used important measure of the buildings' environmental impacts (Fay & Treloar, 2003). The main focus of the literature is on energy and carbon emissions in terms of their impact on the environment.



In this respect, this study focuses on the environmental indicators of energy consumption and carbon emissions. Table 1 shows the life cycle assessment principles and system boundaries defined in the EN 15978:2011 standard.

PRO	BUILDING LIFE CYCLE INFORMATION PRODUCTIO CONSTRUCTIO								INFORMATION EXCEPT FOR BUILDING LIFE Benefits and Loads					
	N STAGE		N STAGE		USE STAGE				STAGE			Beyond the System		
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	
FERIAL EXTRACTION	TRANSPORT	MANUFACTURING	TRANSPORT TO CONSTRUCTION SITE	CONSTRUCTION & INSTALLATION	USE	MAINTENANCE	REPAIR	REFURBISHMENT	REPLACEMENT	CONSTRUCTION & DEMOLITION	TRANSPORT	WASTE PROCESSING	DISPOSAL	REUSE RECOVERY RECYCLING POTENTIAL
RAW MAI	RAW MATERIAL TRANSI		TRANSPOR	COL	B6 OPERATIONAI ENERGY CONSUMPT B7 OPERATIONAL WA CONSUMPTION			ION	DE-O		WAS			

Table 1. Life Cycle Assessment Principles and System Boundaries (EN 15978:2011)

As shown in Table 1, energy consumption, carbon emissions and other environmental emissions occur for each stage and sub-parameters within the life cycle system boundaries. The building's energy consumption during its life cycle is in the form of operational and embodied energy. Operational (usage) energy refers to the energy consumed for heating-cooling, ventilation, lighting, and equipment to provide comfort conditions in the interior. Embodied energy refers to the energy required for all activities in material production, building construction, transportation, maintenance and repair, and end-of-life management (Azari & Abbasabadi, 2018). The carbon impacts of a building on the environment throughout its lifespan are also considered as operational and embodied carbon. The difference between embodied and operational energy characteristics is the same for carbon emissions.

Life cycle costing (LCC) also uses the life cycle approach but from an economic perspective (Hasik et al., 2019). LCC provides the identification and quantification of all costs of a building's life cycle and aims to optimize the cost of the structure throughout its life cycle. Life cycle cost can be a decision tool to choose the best alternative. Life cycle costing is a valuable technique that can be used to analyze and evaluate the cost performance of a building. According to ISO 15686-5 (2017), the LCC framework is defined as four phases: construction, operation, maintenance, and end-of-life. Structural elements constitute the largest percentage of the total building materials and have a greater environmental impact than most other building elements, such as cladding, flooring, and roofing (Stek et al., 2011). The decision regarding a building's structural frame selection, therefore, has a major impact on the building's environmental impact and life cycle cost. In this study, it is the purpose to explain and to analyze structural systems in terms of life cycle environmental impacts and life cycle costing.



METHODOLOGY

First of all, the LCA and LCC framework are explained. LCA and LCC boundaries are determined in terms of structural systems. LCA and LCC analyses are performed using Gabi Software. The reinforced concrete-framed building is handled, which is important for Türkiye's building stock for analysis. A 7-story building with a 400 m2 floor area is selected. The structural system is considered a frame system (column-beam). Shear walls, floors, and foundation are not taken into consideration. The building's gross area is 400 m². The distance between columns is 500 centimeters. The column size is 40x40 cm. Beam width is 40 cm, and the height is 45 cm. Table 2 shows the properties of the reinforced concrete framed building.

Table 2. Reinforced	Concrete Framed	Building's Properties
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Parameter	Details
Building type	Residential Building
Study period	50 years
Gross area	400 m^2
Building Story and total height	7-story and 21m
Structural frame type	R.C. Frame
Structural materials	Concrete, rebar
Concrete amount (t)	789,6 tons
Rebar amount (t)	43,33 tons

LCA and LCC analyses are performed using Gabi Software. GaBi is an LCA software and tool designed to reduce carbon and other environmental emissions and contribute to sustainability. By analyzing the whole life cycle of a product from raw material extraction to disposal, LCA is a tool that will provide environmentally friendly decision-making (Sphera, n.d.). The findings obtained as a result of the analysis are evaluated and explained in the light of literature. The findings are compared with similar LCA and LCC studies. The relationship between LCA, LCC, and structural systems is evaluated.

FINDINGS AND DISCUSSION

The Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) system boundaries for structural systems defined in this study are shown in Table 3. LCA is handled in four basic modules. The production module consists of the subcategories of raw material extraction, transportation, and construction material production. The construction module includes the subcategories of transportation to the construction site and construction or installation. The end-of-life module consists of all the subcategories related to the demolition of the building and the transportation of all materials to landfills or recycling facilities. Life cycle recovery or contribution refers to recovery in terms of energy and emissions. Recycling and reuse potential of structure system are effect and determine the energy and emissions recovery. Life Cycle Costing (LCC) is also handled in four basic modules. Each module and subcategory in the life cycle assessment of structural systems should also be analyzed for life cycle costing because there are cost flows in each module.

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Life Cycle Approach	Modules	Sub-Categories			
		Raw Material Extraction			
	Production Module	Transportation			
		Material Production			
	Construction Module	Transportation to Site			
Life Cycle		Building Construction			
Environmental Impact		Demolition/Deconstruction			
Environmental impact	End-of-Life Module	Transportation			
	Liiu-oi-Liie Module	Waste Processing			
		Disposal			
		Energy Recovery			
	Construction Module	Emission Recovery			
	Production Module				
	Construction Module				
Life Cycle Costing	End-of-Life Module				
	LCC Recovery &	Cost Recovery			
	Construction Module				

 Table 3. LCA and LCC System Boundaries for Structural Systems

This study does not handle the use modüle. Because international standards determine the life of the load-bearing system as 100 years. In the Life Cycle approach, the life span is generally accepted as 50 years. At the same time, the repair or deconstruction and reuse of a load-bearing system requires static or seismic performance analysis. The International Energy Agency (IEA) states that scenarios must be planned for maintenance, repair, and reuse of the structural systems in ANNEX 57 (IEA ANNEX 57, 2016). In line with the framework defined for structural systems, a reinforced concrete framed building is analyzed in terms of life cycle environmental impacts and life cycle costs via GaBi LCA software. Transport and raw material extraction effects are not evaluated in the analysis. The total embodied energy, embodied carbon, and life cycle cost amounts of the structural frame are explained. Carbon results are stated as Global Warming Potential (GWP) in some studies in the literature and especially in LCA software. Therefore, two impact indicators are explained in the study. Table 4 shows LCA and LCC results.

Table 4. LCA and LCC Results						
Parameter	Indicator	Result				
LCA	Embodied Energy Mj	9,4E005 Mj				
Environmental Impacts	Embodied Carbon (GWP) kgCO2-eq	4,19E005 kgCO2- eq				
LCC	Total Life Cycle Cost (£)	2,74E005 £				



The mathematical meaning of the results described in Table 4 is explained. The total amount of embodied energy of the reinforced concrete structural frame throughout its life cycle is 9.4×10^5 Mj. The total amount of embodied energy of the reinforced concrete structural frame throughout its life cycle is 4.19×10^5 kgCO2-eq. The total life cycle cost of reinforced concrete structural frame throughout its life cycle is 2.74×10^5 £. The findings obtained are reasonable in terms of the literature. Studies in the field of LCA, LCC, and structural systems are explained, and the findings are evaluated in the light of the literature. First of all, Islam et al. (2015) stated in their study that LCA and LCC outcomes depend on the assumptions and system boundaries considered. Life cycle outcomes also depend on building typology, choice of construction techniques, and the scope of the study. This study emphasizes that life cycle environmental impacts and cost outcomes are determined by different life cycle stages of buildings.

In Lu et al. (2017)' study, the life cycle assessments of five structural frame alternatives for the structural frame of a 4-storey apartment building to be constructed in accordance with the Australian building codes are compared. These structural alternatives are Laminated Veneer Lumber (LVLm) from early to mid-rotation hardwood plantation logs, LVL from mature hardwood plantations (LVLh), LVL from mature softwood plantations (LVLs), steel, and concrete. The results of the study indicated that LVL generally performed steel and concrete structural frames. In particular, LVL had the lowest values, less than a quarter of the concrete frame, in terms of GWP (2.84E4±233 kg-CO2-eq) and LCC (\$128,855±2797). However, LVL has a Human-toxicity Potential impact that is higher than the steel option.

In the study by Nässén et al. (2012), the net present cost of concrete and wood buildings is compared with the total material, energy, and carbon dioxide costs. The study concluded that the difference in material costs between the two alternatives is small and that wood buildings are uncertain as a more cost-effective option. However, it is also stated that LCC studies did not include labour, construction, maintenance, and demolition costs. Kim et al. (2013) quantitatively compared the environmental load and construction cost of two traditional structural frame types in their study by focusing on the construction phase, in line with the LCA and LCC systematics. The study took into account the cost of CO2 emissions. The findings showed that the LCC of concrete buildings is approximately 10% lower than the LCC of steel buildings. As a result, the usefulness of a structural system in terms of environmental or cost performance is directly related to the context of the study. Context is an important factor that can affect the usefulness of a building element or material.

CONCLUSION AND SUGGESTIONS

As a result, this study focuses on life cycle assessment and LCC approaches in terms of structural systems. It provides a system boundary for LCA and LCC assessments in terms of structural systems. The reinforced concrete structural frame analyzed in the study is evaluated in the light of literature. The importance of life cycle assessment in the selection of structural systems and the impact of the context of the study are emphasized.

Life cycle environmental impact and life cycle cost are objects that need to be optimized. However, the impact of building elements on the environment should be considered as the primary consideration. The cost-effectiveness of a structural system with high energy consumption and environmental emission amounts should not be evaluated as an advantage. When selecting the load-bearing system with optimum performance, international limit values or codes should be determined, especially regarding environmental performance.



It is important to support the environmental argument with the cost issue for the structure selection, especially for an effective application area. However, best cost approach should be adopted instead of lowest cost. The boundaries of the study and the relationship between the life cycle systematics and the building element should be understood and defined. As a result, this study stated that the importance of optimum life cycle performance in the selection of the structural system.

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BIOPHILIC DESIGN TRENDS IN OFFICE INTERIOR DESIGN IN HO CHI MINH CITY

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ABSTRACT

This research paper investigates biophilic design trends within contemporary office spaces in Ho Chi Minh City, Vietnam. With rapid urbanization negatively impacting human connection with nature, biophilic design emerges as a crucial solution, integrating natural elements into workplaces to enhance employee productivity, health, and psychological well-being. Through analyzing local trends, four prominent biophilic design strategies were identified: indoor plants (35%), maximizing natural lighting and open layouts (20%), sustainable materials usage (25%), and nature-inspired imagery (20%). Each trend's implications for employee satisfaction, productivity, and sustainability are discussed, supported by relevant academic and practical case studies. The paper further examines notable local implementations, such as Nestlé's Ho Chi Minh City office designed by ADP Workplace, to demonstrate practical benefits and challenges encountered. Recommendations for effective biophilic implementation in future developments are also provided, emphasizing policy support, corporate leadership, public awareness, and technological innovations. Ultimately, the paper argues for broader adoption of biophilic principles in urban office design to foster sustainable urban development and improved human-environment interactions.

Keywords: Biophilic design, indoor plants, natural lighting, sustainable materials, workplace wellness, office interiors, Ho Chi Minh City, urbanization, employee well-being

INTRODUCTION

In recent decades, urbanization has dramatically reshaped cities worldwide, leading to densely populated environments characterized by limited interaction with natural ecosystems. Ho Chi Minh City, Vietnam's economic powerhouse, exemplifies this phenomenon with its rapid urban expansion, rising population densities, and increasingly stressful working conditions. Employees in urban office settings often face challenges such as limited exposure to natural elements, increased stress, reduced productivity, and diminished overall well-being. These issues underscore the critical importance of creating office spaces that not only enhance productivity but also significantly contribute to the physical, psychological, and emotional health of employees.

Biophilic design, derived from the concept of biophilia coined by biologist Edward O. Wilson (1984), refers to the intrinsic human inclination to affiliate with nature. Biophilic design incorporates natural elements—such as vegetation, natural lighting, water, natural materials, and imagery inspired by nature—into architectural and interior design, aiming to reconnect individuals with the natural world. Research has consistently demonstrated that biophilic design can improve cognitive function, reduce stress, enhance creativity, and increase overall workplace satisfaction.

The application of biophilic principles in office design is gaining significant traction in Ho Chi Minh City as businesses increasingly recognize the value of sustainable, healthy, and productive workplaces. However, the specific nature, implementation challenges, and impacts of biophilic elements within this context remain underexplored.



This research aims to investigate contemporary trends in biophilic office interior design within Ho Chi Minh City, identifying key practices and evaluating their impacts on employee well-being, productivity, and sustainability. Through analyzing current trends and specific case studies, such as Nestlé's office designed by ADP Workplace, this paper provides insights and recommendations to facilitate broader adoption and effective integration of biophilic principles in urban office environments, thus contributing to sustainable urban development and improved human-environment interactions.

THEORETICAL BACKGROUND AND PRINCIPLES OF BIOPHILIC DESIGN

The concept of biophilia, introduced by Edward O. Wilson in his seminal work in 1984, posits that humans possess an inherent affinity toward nature due to evolutionary development. This biophilic instinct suggests that interaction with nature is vital to human psychological and physiological well-being. Building upon Wilson's theory, the discipline of biophilic design has emerged, emphasizing the deliberate integration of natural elements into built environments to reconnect individuals with the natural world.

Biophilic design is grounded in the understanding that nature has restorative properties, fostering environments conducive to mental rejuvenation, improved concentration, and emotional well-being. Kellert, Heerwagen, and Mador (2008) established a foundational framework outlining key biophilic design principles, categorizing them into three main approaches: direct connection with nature, indirect connection with nature, and space and place conditions.

Direct connection to nature includes incorporating actual elements of the natural environment within buildings, such as plants, green walls, water features, and access to natural ventilation and daylight. The presence of plants, for instance, has been widely studied and shown to significantly improve air quality, reduce stress levels, and elevate overall mood and productivity in work environments.

Indirect connection to nature involves the use of representations or simulations of natural elements rather than their direct presence. This approach often employs natural materials such as wood, bamboo, stone, and natural fabrics, as well as textures, colors, patterns, and artwork inspired by nature. These indirect connections evoke sensory experiences associated with natural environments, eliciting similar physiological and psychological responses.

Space and place conditions refer to architectural and spatial arrangements that foster human connection to nature. This includes elements such as spatial openness, visual and physical access to natural settings, and dynamic conditions that mirror natural processes. Daylighting strategies, open office layouts, windows providing views of natural landscapes, and structures mimicking organic forms or patterns exemplify this approach.

Several studies have further expanded upon these principles by identifying specific patterns of biophilic design. Browning, Ryan, and Clancy (2014) introduced a comprehensive framework consisting of 14 patterns, divided into nature in the space, natural analogues, and nature of the space. Nature in the space incorporates direct sensory experiences of nature, natural analogues focus on indirect evocations of nature, and nature of the space addresses spatial configurations that induce feelings of shelter, refuge, and exploration.

Furthermore, recent research underscores the growing importance of biophilic principles in urban environments experiencing rapid development. Salingaros (2019) emphasized biophilia's critical role in creating healing environments and reducing urban stress.



As Ho Chi Minh City continues its trajectory of urbanization, biophilic design presents a potent strategy to counterbalance the adverse effects of urban stressors, providing holistic benefits not only to individual well-being but also to organizational productivity and sustainability.

This comprehensive theoretical foundation serves as the framework for the current research, guiding the exploration and analysis of biophilic design implementations within the context of office spaces in Ho Chi Minh City. By examining these core principles and their practical applications, this paper aims to elucidate the significance and effectiveness of biophilic design in fostering sustainable, healthy, and resilient work environments.

METHODOLOGY

This research employs a mixed-methods approach combining qualitative and quantitative research methods to thoroughly investigate biophilic design trends in office spaces within Ho Chi Minh City. The mixed-method approach allows for comprehensive data collection, analysis, and interpretation, effectively addressing the complexity and multidimensional nature of biophilic design implementation and its impacts.

The research begins with an extensive literature review, gathering foundational concepts, theoretical frameworks, and prior empirical studies to establish a strong theoretical and contextual background. This stage involves analyzing academic articles, industry reports, books, and organizational guidelines relevant to biophilic design, sustainable architecture, workplace wellness, and urban development.

Qualitative research is conducted through semi-structured interviews with architects, interior designers, office managers, and employees from selected office spaces known to implement biophilic design elements. These interviews explore practical experiences, motivations, benefits, challenges, and recommendations associated with integrating natural elements in office interiors. The participants are selected using purposive sampling, focusing on professionals and stakeholders directly involved in designing or experiencing biophilic office spaces.

Quantitative data is gathered through surveys distributed to employees working in offices incorporating biophilic elements. The survey questionnaires include Likert-scale questions and open-ended items, evaluating employees' perceptions of workplace satisfaction, productivity, emotional and physical well-being, and overall attitudes toward biophilic design. Survey data is statistically analyzed using descriptive statistics and inferential techniques, including correlation analysis, to examine relationships between biophilic elements and employee outcomes.

Additionally, this research analyzes specific case studies, prominently featuring Nestlé's Ho Chi Minh City office designed by ADP Workplace. These case studies are carefully selected based on their exemplary use of biophilic design elements and their recognized contributions to employee well-being and sustainable practices. Detailed examinations of each case involve document analysis, observational visits, photographic documentation, and structured assessments based on recognized biophilic design evaluation frameworks.

Data gathered from the literature review, qualitative interviews, employee surveys, and case studies are triangulated to enhance reliability, validity, and comprehensiveness of findings. The mixed-method design ensures an integrated understanding of how biophilic principles are applied in Ho Chi Minh City's office interiors, their practical impacts on stakeholders, and opportunities for future development.



ANALYSIS OF BIOPHILIC DESIGN TRENDS

The analysis of biophilic design trends within office spaces in Ho Chi Minh City reveals several prevalent and influential approaches. These trends are categorized and discussed based on their frequency of adoption and the specific benefits they bring to the workplace environment. Four significant trends have emerged clearly from the collected qualitative and quantitative data: indoor plants, maximizing natural lighting and open layouts, sustainable and natural materials, and nature-inspired imagery.

Indoor Plants (35%)

The most prominent biophilic trend observed is the integration of indoor plants into office spaces. Offices in Ho Chi Minh City increasingly adopt plants due to their immediate visual impact and measurable benefits to employee well-being and productivity. Indoor plants enhance air quality by filtering harmful toxins and pollutants, thus significantly improving indoor environmental quality. Popular choices among local offices include snake plants, spider plants, peace lilies, and ferns, which are recognized for their air-purifying qualities and ease of maintenance.

Moreover, the presence of greenery in workspaces has been linked to reduced stress levels, enhanced creativity, and greater employee satisfaction. Office designs featuring vertical gardens, green walls, and potted plants not only aesthetically elevate interiors but also contribute to psychological restoration, reducing cognitive fatigue among employees. Interviews conducted during the research confirmed that employees experienced increased comfort and productivity due to the calming and refreshing atmosphere created by these natural elements.

Maximizing Natural Lighting and Open Layouts (20%)

Another notable biophilic trend is the emphasis on maximizing natural lighting and adopting open layouts. Designers and architects in Ho Chi Minh City increasingly favor open floor plans, large windows, glass partitions, and skylights to allow ample natural daylight to permeate office interiors. Natural light not only reduces reliance on artificial lighting—thus lowering energy consumption—but also positively affects employee mood, circadian rhythms, and productivity.

The data from employee surveys indicated a strong preference for natural lighting, with respondents reporting higher satisfaction, improved mental clarity, and reduced feelings of fatigue when exposed to sufficient daylight. Open layouts further enhance this trend by fostering collaborative work environments and transparency, strengthening social interactions among colleagues. Observations of office spaces in Ho Chi Minh City demonstrate that open layouts and daylight-rich environments consistently improve teamwork and employee engagement.

Natural Materials and Sustainable Design (25%)

The incorporation of natural and sustainable materials represents a significant biophilic trend in office design in Ho Chi Minh City. Materials such as wood, bamboo, stone, and recycled or reclaimed materials are increasingly integrated into office interiors. These materials evoke feelings of warmth and authenticity, providing employees with subtle yet meaningful connections to nature. Natural textures, colors, and finishes reduce the sterile and artificial feel of traditional office environments, enhancing aesthetic appeal and employee well-being.

Interviews with designers and office managers underscored the growing corporate commitment to sustainability and environmental responsibility. Companies embracing sustainable practices and natural materials reported improvements in employee retention, brand reputation, and workplace satisfaction.



Additionally, survey results revealed positive associations between employees' perceptions of sustainable materials in their workplaces and their overall job satisfaction, sense of pride, and commitment to their organizations.

Nature-Inspired Imagery (20%)

The use of nature-inspired imagery constitutes an indirect biophilic approach, significantly contributing to the visual and psychological appeal of office spaces in Ho Chi Minh City. Patterns, textures, artwork, murals, and decorative elements inspired by natural forms—such as leaves, water, mountains, or animal motifs—are increasingly prevalent. These elements offer a cost-effective way to foster psychological connections to nature, especially in densely built urban environments where direct access to outdoor nature might be limited.

Employees surveyed expressed that nature-inspired imagery within office interiors significantly contributed to creating relaxing and inspiring environments. Such imagery helps employees manage stress better and encourages creativity and innovative thinking. Observational data from several offices indicated that carefully chosen nature-themed designs, such as artwork and murals, effectively elevate the atmosphere and foster positive emotional responses from employees.

In summary, the analysis of biophilic trends demonstrates their widespread and diverse applications within Ho Chi Minh City's office environments. Each trend offers distinct yet complementary benefits, collectively contributing to healthier, more sustainable, and productive workplaces. This detailed analysis provides essential insights into the practical implementation and impacts of biophilic design principles, underscoring their vital role in enhancing employee well-being and organizational success.

CASE STUDIES ANALYSIS

To provide practical insights and tangible examples of biophilic design principles applied within office environments in Ho Chi Minh City, this study extensively examines two prominent cases: the Nestlé office by ADP Workplace and Toong Co-working space. Both cases showcase unique applications of biophilic elements tailored to their specific organizational cultures, operational needs, and sustainability goals.

Nestlé Office by ADP Workplace

Nestlé's office in Ho Chi Minh City, designed by ADP Workplace, embodies the strategic integration of biophilic design principles aimed at promoting employee wellness, collaboration, and environmental responsibility. The office covers approximately 3100 square meters, demonstrating a thoughtful approach to space optimization and biophilic integration.

The key biophilic elements featured prominently include extensive use of indoor plants, strategic maximization of natural lighting through glass façades, and open floor plans enhancing spatial connectivity. Indoor plants are thoughtfully placed throughout the workspace, contributing to visual appeal, air purification, and stress reduction. Additionally, the use of natural materials such as bamboo and reclaimed wood reinforces Nestlé's commitment to sustainability, creating a warm and welcoming environment that connects employees to natural textures and colors.

The design incorporates flexible, collaborative spaces alongside private work areas, enabling both teamwork and individual productivity. Employee feedback gathered through interviews and surveys indicates increased satisfaction, motivation, and productivity. The combination of biophilic elements has fostered a positive work culture, contributing significantly to Nestlé's broader objectives of employee wellness and sustainable corporate practice.



Challenges faced in implementing the biophilic approach included maintaining plants, balancing open and private spaces, and ensuring sustainable sourcing of materials. Nevertheless, careful planning and ongoing management have successfully addressed these challenges, resulting in a sustainable and productive workspace that reflects the company's values and aspirations.

Toong Co-working Space

Toong, a leading co-working space provider in Ho Chi Minh City, represents an innovative application of biophilic design principles, effectively aligning workplace wellness with creativity and collaboration. Recognizing the need for spaces that encourage productivity, creativity, and wellness among diverse groups of professionals, Toong has strategically leveraged various biophilic elements to enhance the work environment.

The standout feature of Toong's design is the extensive integration of greenery, including vertical gardens, hydroponic walls, and thoughtfully positioned indoor plants. These elements not only enhance aesthetic appeal but significantly improve air quality, creating an environment conducive to long hours of productive work. Natural lighting is skillfully maximized using large windows and glass partitions, ensuring ample daylight exposure, which positively impacts employee mood, alertness, and productivity.

Natural materials such as bamboo, wood, and other sustainable materials are prominently featured in furniture and interior finishes, reinforcing a commitment to ecological responsibility. Additionally, nature-inspired imagery, including murals and artwork inspired by local flora and fauna, reinforces the psychological connection to the natural world, fostering creativity and reducing workplace stress.

Feedback from Toong's members highlights significant positive impacts on productivity, innovation, and overall workplace satisfaction, validating the effectiveness of their biophilic approach. Despite challenges related to ongoing maintenance of greenery, initial investment costs, and balancing aesthetics with functionality, Toong's meticulous approach to design management and user involvement has effectively overcome these barriers.

Comparison and Insights

Both Nestlé and Toong Co-working spaces exemplify the strategic integration of biophilic design principles within diverse workplace environments in Ho Chi Minh City. While Nestlé focuses on employee wellness, sustainability, and corporate culture, Toong emphasizes innovation, flexibility, and community building. Both approaches yield substantial benefits, notably enhanced productivity, improved employee well-being, and increased workplace satisfaction.

The detailed analysis of these cases underscores the importance of tailored biophilic interventions aligned with organizational objectives and operational contexts. Insights derived from these case studies highlight essential factors for successful implementation, including thoughtful spatial planning, material selection, user involvement, and sustained maintenance efforts. These practical lessons serve as valuable guidelines for other organizations considering adopting biophilic design principles in their workplaces.

BENEFITS AND CHALLENGES

The implementation of biophilic design in office interiors across Ho Chi Minh City has generated substantial benefits, though it also presents distinct challenges. Understanding both the advantages and limitations is crucial for effectively adopting biophilic principles.



Benefits

The foremost benefit of biophilic design in office spaces is enhanced employee well-being. Incorporating natural elements such as indoor plants and natural lighting significantly improves air quality, reduces stress, and enhances overall mood and cognitive function. Surveys and interviews conducted during this research highlighted reduced absenteeism, greater job satisfaction, and increased employee retention rates among organizations utilizing biophilic designs.

Moreover, biophilic offices have shown measurable productivity improvements. Natural elements foster concentration, creativity, and innovation by providing restorative environments that help employees recover from cognitive fatigue. Observational data from offices studied demonstrate increased employee focus, higher efficiency, and better teamwork, attributable directly to biophilic interventions.

Sustainability is another substantial benefit. Offices adopting biophilic principles often emphasize sustainable material use and reduced energy consumption through natural lighting strategies, significantly lowering their environmental footprint. Enhanced brand reputation associated with sustainability also positively impacts market positioning and public perception.

Challenges

Despite these notable benefits, the application of biophilic design presents several challenges. One primary barrier is the initial financial investment required. The integration of sophisticated green elements, sustainable materials, and architectural modifications can entail significant upfront costs. These financial considerations can deter businesses, especially smaller firms with limited budgets.

Maintenance poses another significant challenge. Biophilic design elements like plants, green walls, and water features require consistent and specialized maintenance. Inadequate maintenance practices can result in reduced effectiveness, negatively affecting aesthetics and workplace health.

Space constraints, particularly prevalent in densely populated urban areas like Ho Chi Minh City, further complicate biophilic implementation. Limited physical space can restrict the types and scale of biophilic features that can be integrated effectively. This issue requires innovative design solutions tailored specifically to smaller, more compact environments.

Lastly, limited awareness and understanding of biophilic design principles among businesses and stakeholders can slow widespread adoption. Comprehensive educational efforts are necessary to enhance recognition of biophilic design's potential benefits and practical applications.

RECOMMENDATIONS FOR FUTURE DEVELOPMENT

Given the benefits and challenges identified, this paper outlines several recommendations aimed at promoting the broader adoption and successful implementation of biophilic design within Ho Chi Minh City's office environments.

Government Support and Policy Initiatives

Government involvement through supportive policies, regulations, and incentives can significantly encourage biophilic design adoption. Initiatives could include tax incentives, subsidies for companies investing in biophilic elements, and mandated green-building certifications. Establishing clear regulatory frameworks and guidelines will provide businesses with practical pathways and incentives for adopting sustainable biophilic practices.



Corporate Leadership

Corporate leadership plays a critical role in setting industry standards and demonstrating the value of biophilic design. Prominent companies successfully adopting biophilic principles can serve as role models, influencing other businesses to follow suit. Establishing case studies, conducting public seminars, and openly sharing positive outcomes can help demonstrate the tangible benefits, thus motivating broader adoption.

Educational and Awareness Campaigns

Public awareness campaigns and educational initiatives are necessary to inform businesses and stakeholders about biophilic design benefits and implementation strategies. Workshops, seminars, webinars, and information sessions targeting architects, designers, business leaders, and employees can significantly increase knowledge and awareness. Partnerships between industry associations, universities, and government agencies can effectively deliver these educational efforts.

Technological Innovation and Research

Leveraging technological advancements can address challenges related to maintenance and space constraints. Innovations such as automated plant maintenance systems, smart building technologies for optimizing natural lighting and ventilation, and digital design tools for planning biophilic elements in compact spaces can make implementation easier and more effective. Continued research and development into these technologies will support broader, more efficient adoption.

Collaboration and Community Engagement

Finally, fostering collaboration among designers, businesses, community organizations, and governmental bodies can drive successful biophilic implementation. Engaging local communities in participatory design processes ensures alignment with cultural preferences, local climate considerations, and community-specific needs. Collaborative networks can facilitate resource sharing, joint initiatives, and the development of standardized best practices for biophilic office designs.

In conclusion, by addressing financial, maintenance, spatial, and awareness challenges through proactive policy measures, corporate leadership, educational initiatives, technological innovations, and collaborative community involvement, Ho Chi Minh City can significantly enhance the adoption and effectiveness of biophilic design. This comprehensive approach will help foster sustainable, productive, and health-promoting office environments across the urban landscape.

CONCLUSION

The comprehensive analysis of biophilic design trends within office interiors in Ho Chi Minh City highlights their growing importance and multifaceted benefits in contemporary workplace environments. This research underscores the transformative potential of biophilic design to significantly enhance employee well-being, productivity, and overall organizational performance, positioning it as a critical component of sustainable urban development.

Findings demonstrate that integrating natural elements, such as indoor plants, abundant natural lighting, sustainable materials, and nature-inspired imagery, substantially contributes to healthier and more productive workplaces. Employees working in biophilically designed offices report enhanced satisfaction, reduced stress, and increased creativity and innovation, clearly illustrating biophilic design's direct impact on human-centered outcomes.



Additionally, sustainable practices embedded within biophilic design further reinforce environmental responsibility, reducing the ecological footprint of office spaces and promoting sustainable urban growth.

However, the implementation of biophilic design presents specific challenges, including initial investment costs, ongoing maintenance requirements, space constraints typical of densely populated urban centers, and limited awareness among stakeholders. Successfully overcoming these barriers necessitates coordinated efforts from various sectors, including government entities, corporations, educational institutions, and community organizations.

This study's recommendations provide clear pathways to overcome these implementation challenges. Enhanced government support through policy incentives, corporate leadership exemplified by successful business models, widespread educational initiatives to raise awareness, technological innovations to address practical constraints, and collaborative community engagement represent comprehensive strategies to effectively mainstream biophilic design in Ho Chi Minh City.

Ultimately, embracing biophilic design offers profound opportunities to positively reshape urban work environments, ensuring they are not only efficient and productive but also nurturing and sustainable. This research contributes valuable insights and practical guidelines, empowering stakeholders to leverage biophilic principles effectively. As urbanization continues to accelerate, particularly in dynamic cities like Ho Chi Minh City, biophilic design stands out as an essential approach to harmonizing urban growth with human well-being and ecological sustainability. Continued exploration, research, and implementation of biophilic strategies promise lasting benefits for individuals, organizations, and the broader urban community, fostering healthier, happier, and more sustainable urban futures.

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THE CHALLENGE OF SLUMS AND INFRASTRUCTURE PROVISION: THE CASE OF SIDI GHAZAL NEIGHBORHOOD IN BISKRA

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ABSTRACT

This study addresses the issue of slums and the provision of infrastructure, focusing on the case of Sidi Ghazal neighborhood in Biskra. Slums, characterized by a lack of basic services such as clean water, sanitation, electricity, and roads, pose significant challenges to urban planning and the quality of life for their residents. Using a comparative analytical methodology, data were collected through field surveys, interviews with residents, and secondary data from governmental and non-governmental sources. The findings highlight the critical need for sustainable urban planning, community participation, and partnerships between public and private sectors to improve living conditions in slums. The study concludes with practical recommendations for integrating slums into the urban fabric and achieving sustainable development goals.

Keywords: slums, infrastructure, sustainable development, urban planning, Sidi Ghazal

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STUDY OF SPECTRAL- LUMINESCENCE PROPERTIES OF NANOCOMPOSITES WITH GaSe QUANTUM DOTS

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ABSTRACT

Semiconductor nanocrystals or quantum dots (QDs) are one of the most interesting and promising objects for research in various fields of science, from materials science to medicine. Semiconductor nanocrystals and composites based on them are used in photovoltaics, optoelectronics, in the creation of new generation light-emitting diodes and as the basis of an active medium for laser generation. They have a higher extinction coefficient compared to dyes and greater photostability, which is maintained at high excitation power densities, which allows the use of quantum dots as highly efficient luminescent labels. Thus, in many cases, quantum dots successfully replace organic phosphors. Since the unique properties of quantum dots are associated with the effect of size quantization, it is possible to control the synthesis of such objects with these properties. The ease of controlling the size of nanocrystals and their bright luminescence create a good platform for use in applied sciences. In addition, quantum dots, when introduced into a solid medium, are widely used as model objects for studying quantum-scale effects in semiconductor quasi-zero-dimensional systems. An analysis of the literature on the topic of the study demonstrates the relevance of conducting research on new objects - semiconductor nanocrystals (NC). Further development of research on semiconductor nanostructures is most effectively possible in two directions: first, it is based on the development of synthesis methods that allow you to adjust the spatial structure of the synthesized materials in order to obtain the necessary functionality from them; the second is related to the optimization of research methods, with the help of which it is possible to make it more accurate. Imperfect methods of synthesis of nanoparticles require modernization, which is possible with the correct study of the properties of the synthesized objects. A detailed description of the properties of the studied objects can be obtained only by a combination of various experimental techniques, and most importantly, techniques that allow studying the properties of the object at the nanoscopic scale with high temporal, spectral and spatial resolution. . Spectromicroscopy of single quantum objects is one of the fastest developing interdisciplinary areas in modern science. This method allows for diagnostics of materials in the solid or liquid state with ultra-high spatial resolution, while simultaneously realizing high spectral details

Keywords; quantum dots, nanocrystal, spectromicroscopy, synthesis, nanoparticle

INTRODUCTION

With all the diversity of semiconductor nanoparticles, a large number of components for electronic devices have been created on their basis, and materials with improved properties are constantly being searched for. Industry is rapidly increasing the use of nanomaterials, which in turn is stimulating the development of synthesis methods for the creation of new objects. The creation of new quantum-scale structures requires a clear understanding of the internal structure of the ongoing quantum-mechanical processes.



It is very important to choose the right synthesis conditions and growth medium to reduce the number of internal defects. Despite great efforts aimed at the development of various synthesis methods, the exact mechanisms of nanocrystal growth are still poorly understood. The creation of quantum dots at all stages will determine the pace of development of applied sciences using quantum-scale objects. A promising direction for obtaining nanoscale materials is the use of structured matrix media.

These include zeolites, molecular sieves, micelles/microemulsions, gels, polymers, glasses, and liquid crystals. At the same time, the most important and urgent problem of the controlled introduction of nanoparticles into various media for the creation of new composite materials is being solved simultaneously with the development of methods for the synthesis of quantum dots.

Among the wide range of quantum dots, one of the most studied and popular objects is nanocrystals based on metal chalcogenides, in particular quantum dots with a GaSe emitting core. The main advantages of such objects are their high optical and chemical stability. Currently, various methods are used to produce such quantum dots: epitaxial growth, colloidal synthesis, template synthesis in nanostructured matrices and porous materials. At the same time, the production of quantum dots faces a number of difficulties associated with the non-ideal properties of the created nanocrystals: the presence of internal and surface defects, the dispersion of the sizes and shapes of Kn, the agglomeration of individual quantum dots. complexes, etc. Among the methods for characterizing synthesized quantum dots, spectroscopic methods occupy a special place, since intra- and intermolecular interactions in quantum dots, their ensembles, and composites based on quantum dots will lead to a change in their spectral-luminescent properties. In particular, the presence of a narrow peak in the luminescence spectrum and its position will allow us to characterize excitation excitations in the studied environments, the dispersion of the sizes of nanocrystals will lead to an additional broadening of the luminescence spectrum of the ensemble of quantum dots; ; the presence of defects in the structure of quantum dots leads to the formation of a recombination band in the luminescence spectrum of the ensemble of quantum dots, a decrease in the effective quantum yield, as well as the presence of a vibrational effect in the spectra. One of the modern methods for synthesizing quantum dots is the template synthesis method of metal alkanoates within ionic thermotropic liquid crystal matrices [4]. Nanocomposites crystallized from the liquid crystal phase of ionic metal alkanoates are optically anisotropic glasses with stabilized quantum dots. This technique is expected to allow for the controlled growth of quantum dots with low dimensional dispersion [5]. Here, the thermotropic phase of the liquid crystal acts as a nanoreactor, within which the synthesis, stabilization and self-assembly of nanoparticles occur, since the synthesis takes place in a multi-level smectic matrix. By controlling the growth process of quantum dots in such a matrix, it is possible to synthesize high-quality materials with the required orientation of nanoparticles. Template synthesis methods, which are becoming increasingly popular in various applications, require the presence of "feedback" in the form of characterization of the synthesized materials using luminescence spectroscopy methods. The aim of this study is to determine the spectral and luminescence properties of nanocomposites with GaSe quantum dots synthesized in the GaSe liquid crystal mesophase.

METHOD, RESEARCH AND RESULTS

The nanocomposite in the form of polycrystalline powder was applied from solution to a glass substrate by centrifugation. The solution was prepared by weighing different amounts of polycrystalline powder in toluene, which is optically transparent for the wavelengths considered, chemically pure neutral. The use of toluene as a solvent also allowed for the removal of large amounts of the solidified liquid crystal matrix.



The suspension was sealed in a 2 ml vial and kept in an ultrasonic bath at an average temperature of 30 ° C for one hour. After the microcrystals were destroyed by ultrasound to a size that was insoluble by the eye, the solution acquired a light brown color, which indicates the colloidal solution (separation from the matrix) of a significant number of CdSe quantum dots in toluene. The amount of powder was selected individually for different experiments. To record the lowtemperature luminescence spectra, 22 µg of powder was dispersed in 2 ml of toluene (hereinafter, samples prepared from such a solution will be referred to as KT-I for brevity). A 0.15 mm thick glass substrate was placed in a centrifuge with a speed set to approximately 5000 rpm, and then the solution was applied to the rotating substrate. After the excess solution was dried and the remaining toluene evaporated, a composite film was formed on the surface. A white light micrograph of such a thin layer is shown in Fig. 1. In the film structure, optically homogeneous regions with evenly distributed GaSe quantum dots (both shell-free and with thin shells of alkanoate matrix residues) are clearly distinguishable. At the same time, numerous micrometer-sized inclusions are observed in the film structure - microcrystallites of GaSe KNs stabilized in their structure. Images with different microscope magnifications are shown. To conduct studies at the level of single emitters, a solution was prepared containing 3 µg of powder per 10 ml of toluene. In this case, it was possible to obtain a sample with isolated CNs (and their small agglomerates) on the surface of a glass substrate. Hereinafter, we will briefly refer to this sample as CT-II. The final concentration of CN in the solution was selected experimentally based on the density of emitting bodies in the field of view of a wide-field fluorescence microscope. It was necessary to ensure that the characteristic distance between the luminescent bodies exceeded the Abbe diffraction limit (i.e., more than a few hundred nm). Otherwise, it would not be possible to distinguish the glow of individual emitters. When large (more than 10 µm) microcrystals were detected, the solution was additionally kept in an ultrasonic bath until the crystallites were more strongly dissolved. The studied glass-fused nanocomposite was synthesized as follows. The synthesized composite polycrystalline powder was placed between two 1.2 mm thick quartz cover glasses. The gap between the glasses, which determined the thickness of the future sample, was set with Teflon strips (10 µm thick), which allowed to avoid uneven compression and, as a result, uneven thickness. Then, the quartz glasses were glued along the perimeter, which prevented mechanical deformation of the future sample. The structure with the powder was heated to 98 °C to the transition temperature of the liquid crystal mesophase of Gaalkanoate (smectic order modification). After reaching the phase transition, the heating was stopped and the sample was rapidly (within 1-2 min) cooled to room temperature, which led to its glass transition [1].

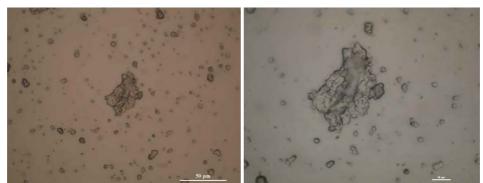


Figure-1. Microscopic photographs of a nanocomposite sample with GaSe dots (2.3 nm) deposited on a glass substrate by centrifugation of a highly concentrated toluene solution of polycrystalline powder.



It is assumed that in this case the short-term order shown in smectic LC is preserved in the matrix [5]. It was then impossible to remove or change the coatings without destroying the sample. The absorption spectra of the studied samples at room temperature were measured on a two-beam UV-Vis Specord M400 spectrophotometer. The maximum possible spectral measurement range from 185 to 1100 nm was selected for this device. The slit width and scanning speed were selected individually for each sample based on the obtained optical density and the half-width of the absorption maximum. The recordings were cut off in the spectral ranges in which there was no signal. The spectra were used to determine the location of the exciton absorption peaks, which were subsequently taken into account in luminescence studies. To record the fluorescence spectra and fluorescence excitation, a setup based on two MDR-72 monochromators designed according to the Czerny-Turner principle with a linear dispersion of 40 Å/mm was used (Fig. 2). The source of the excitation light was a 1 kW Xe lamp DKRSh-1000, the fluorescence was recorded using a CCD camera (Videoscan-415) with the highest spectral sensitivity in the visible region of radiation, and the subsequent output of the signal was connected to a computer. Fluorescence spectra were recorded using excitation light at different wavelengths, and fluorescence excitation spectra were recorded using different recording wavelengths. Measurements were carried out at room temperature and at low temperature (- 77 K). The diameter of the excitation beam was determined by the width of the exit slit of the excitation monochromator (~3 mm). The optical elements used in the setup allowed to focus the exciting radiation on the sample to a spot with a diameter of ~ 0.7 -1 mm. Luminescence and fluorescence excitation spectra were recorded with a sufficiently high spectral resolution, which allowed to record the fine (quasi-linear) structure of the spectra. At the same time, it should be noted that the significant spatial heterogeneity of the nanocomposites led to a significant averaging of the spectral characteristics over the volume of the studied samples. However, this opportunity did not contribute to the study of the spectral composition of the studied region due to the high heterogeneity of the nanocomposites. The recorded spectra allowed to observe a clear interband transition and a wide structureless region in the long-wavelength part of the spectrum. The spectra obtained at room temperature are given (Fig. 2).

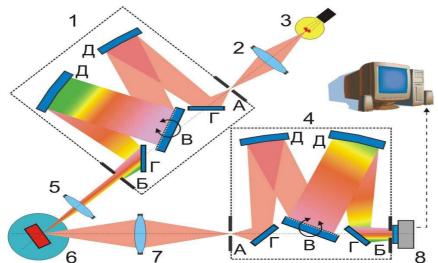


Figure 2. Setup for conducting luminescent studies of bulk materials. 1 – MDR-72 excitation monochromator; A – Entrance slit; B – Exit slit; B – Diffraction reflecting grating; G - Mirrors; D – Concave spherical mirrors; 2 – Convex lens; 3 – Continuous radiation source – Xe lamp; 4 – Recording monochromator MDR-72; 5 – Convex lens; 6 – Sample under study; 7 – Optical collimator; 8 – Detector – CCD camera.



Since spectral studies are of great importance at cryogenic temperatures, similar experiments were carried out at low temperatures. The luminescence and fluorescence excitation spectra averaged over a large sample area were obtained using the previously used scheme. An optically flooded He-4 cryostat was placed at the subject junction of this scheme. Measurements were carried out at the boiling temperatures of the coolants – nitrogen. To study the changing luminescence spectra in areas with structural inhomogeneities, a side-illuminated optical scheme was used (Fig. 3). The use of this technique is associated with limitations and allows the use of a micro-lens with a short front focal length to focus the laser beam on the sample located in the cryostat at a great distance. The cryostat window is 3 cm. In these experiments, the sample temperature was controlled by a Lakeshore 330 temperature controller and increased by a computer-controlled heater mounted on a rod near the sample. Two lasers were used as excitation radiation sources. DPSS with a wavelength of $\lambda = 405$ nm and a nitrogen laser LGI-21 (wavelength of $\lambda = 337.1$ nm, pulse repetition frequency of 50 Hz, pulse duration of 10 nm). The use of an ultraviolet laser is due to the lack of sufficient energy of a solid-state laser ($\lambda = 405$ nm) to pump a sample with 1 nm QDs.

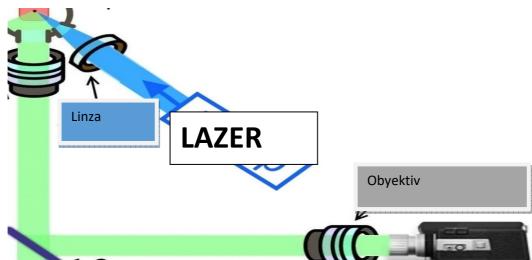


Figure 3: Fluorescence with the ability to measure in a wide range of low temperatures

The regulation and measurement of temperature were carried out using a thermal stabilization scheme in the temperature range from 77 K to room temperature with 5 K steps. The use of the scheme with visualization made it possible to study the dependence of luminescence spectra on structural features at low temperatures. To study structural inhomogeneities that can cause significant inhomogeneous broadening in luminescence spectra, as well as to study the properties of new objects in more detail, a confocal luminescence recording scheme was used [7].

The setup diagram for recording luminescence and its spectral analysis is shown in Figure 4. . The exciting laser radiation was directed through a transparent plate, and then through a microlens to the studied point on the sample. The luminescence was collected through the same microlens. The signal followed a similar path, passing through a transparent plate and entering the recording channel of the spectrometer. The recording channel, branched by a folding mirror, contains a lens with a detector (CCD camera) for visualizing a selected part of the sample. This system allows studying the dependence of luminescence spectra on the structural properties of the sample, recording the spectrum in one channel and studying the microscopic structure in the other channel. This method of excitation and collection of sample luminescence is characterized by high efficiency and high spatial resolution.



The objects were excited by a diode-pumped solid-state (DPSS) laser with an excitation wavelength of $\lambda = 405$ nm and a power of 23-25 mW per excited point. The sample was illuminated mainly through the confocal path, i.e. through the same lens through which the luminescence was collected. If it was not possible to collect the required amount of luminescence from the confocal part of the object to record a good signal-to-noise ratio due to insufficient pump power, additional laser irradiation of the sample was carried out from the opposite side. In this case, the focus on the object area was reduced using the visualization system. The size of the constriction in microscopic images was determined by a reference periodic structure - a microelectrode contrast optical marker . In these experiments, the laser beam was focused on an area with a linear size of several tens of microns. A compact echelon spectrometer was used as a spectral recording system. With its help, it was possible to obtain spectral data in the entire visible range at high speed at once. Using a confocal microscope equipped with a visualization system, the microscopic structure of the samples was studied, the relationship between the observed areas and their spectral composition was analyzed. We examined areas of the sample without visible defects, but at the same time the emission area remained relatively large. Within the study area, they may be Microscopic defects that affect the signal emission from the nanocrystals.

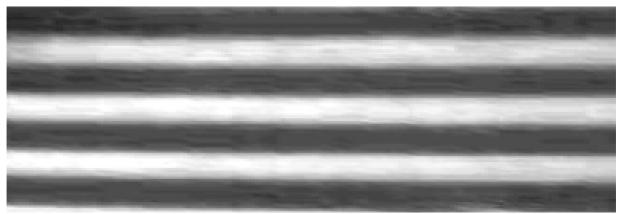


Figure 5. Microelectrode contrast grid for determining absolute dimensions in the sample structure. The width of each (light/dark) strip is 10 μm.

To conduct spatial-spectral tomography (mapping) of the samples, as well as studies at the level of single CN scans, an experimental setup based on a confocal fluorescence microscope combined with a prism spectrometer was used (Fig. 6). The sample in the form of CN, deposited by centrifugation on the surface of a cover glass, was placed in the object section of the confocal microscope on a precision platform controlled by piezoceramic actuators to move the sample along three coordinates. With its help, stepwise displacement of the sample in the horizontal plane and simultaneous synchronous recording of the luminescence spectrum at each point were carried out. Depending on the required accuracy and the area of the studied region, the displacement step in each experiment changed, the smallest step was 0.5 µm. The position of the sample on the scanned precision slide was controlled by a computer. Observation of the luminescence signal was carried out in the recording channel using an ANDOR Luca EMCCD camera. In the parallel recording channel, a high-sensitivity The EMCCD camera ANDOR Ixon collected the luminescence signal after splitting it into a spectrum using a prism. The calibration of the spectral lines was carried out according to the position of the lines in the spectrum of a neon lamp. The exposure time for the spectrum recording was 300 ms and varied within small limits to achieve the best balance between the intensity of the recorded signal, the signal-to-noise ratio and the dynamic range of the camera.



By using a transparent plate and a filter separating the two recording channels to cut off the laser radiation, it was possible to simultaneously acquire the luminescent sample and record the spectrum from a selected area. All experiments described below were performed at room temperature. Several lasers were used as the source of luminescence excitation: 1) a continuous diode-pumped solid-state laser with a wavelength of 405 nm; 2) a continuous diode-pumped solid-state laser with a wavelength of 532 nm (Coherent, Verdi V6), which was used for both luminescence excitation and tunable laser pumping; 3) a single-frequency dye laser (rhodamine 6G) with a linear resonator (Coherent, CR599) with the possibility of tuning the wavelength from 560 to 610 nm. In experiments with single emitters, the characteristic power density of the exciting radiation was chosen significantly below the values at which significant photodegradation of the sample was observed and amounted to 86.6 kW/cm2. In the experiments, two micro-lenses were used to direct the exciting radiation onto the sample: an immersion objective (Nikon) with a 100-fold magnification and a numerical aperture of 1.25 and an air objective (Nikon) with a 100-fold magnification and a numerical aperture of 0.95. The fluorescence signal was collected in confocal mode using the same microobjectives. The first series of 2D tomography experiments to study the nanocomposite for the presence of microscopic defects was performed with KN-I samples. A 150*150 µm area was scanned, divided into 4 equal squares with a step of 1 µm, and the luminescence spectrum was recorded at each stage. The selection of the area was not random, but was determined by the luminescence spectrum of the entire region and was carried out by comparing it with previously obtained spectral data and microscopy. Then, synchronously with the movement of the slider with a certain step, the luminescence spectrum was recorded at each point of the selected part of the sample. Spatial-spectral tomograms were constructed by computer processing of the experimental data. A similar method was used to study samples prepared from a weakly concentrated solution for studies at the level of single quantum emitters. The study area was 25*25 µm and the movement was performed in 500 nm increments. Since photon antibunching measurements were not performed in this study, the single nature of the quantum emitters found can be confirmed by determining the presence of vibrational and/or spectral diffusion processes. Additional measurements were performed using the high-resolution transmission electron microscopy (HRTEM) technique to characterize the single nanocrystals.

CONCLUSION

In this work, the luminescence, absorption and luminescence excitation spectra of cadmium selenide nanocrystals (quantum dots) synthesized in the LC phase of GaSe with characteristic sizes of 1.8 and 2.3 nm were studied in a wide temperature range. The spectra of nanocomposites were recorded in different sections of the sample, differing in structure, including spectra containing various defects formed during the sample preparation process. The dependence of luminescence spectra on temperature and KN size was analyzed. This article describes the experimental methods and sample preparation methods. The combination of the equipment used allows for a comprehensive spectral-luminescence analysis of objects. Depending on the tasks set (for example, the characteristic scale of the samples under study and the required spatial resolution), various experimental methods can be used, as well as their combinations:

- spectrophotometry at room temperature;

- detection of luminescence spectra of macroscopic samples at room and cryogenic temperatures;

- scanning confocal fluorescence microscopy, including. by detection of luminescence spectra for spectral-spatial tomography of thin films;

- high-resolution transmission electron microscopy.

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KOMPLEKS ÜNİVERSİTE YAPILARININ ENERJİ TÜKETİMİNE YAPI KABUĞU ÖZELLİKLERİNİN ETKİSİ

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ÖZET

Çalışmada, yapı kabuğunda ülkemiz en son 2013 yılında yenilenen yalıtım stanadardı TS 825'te tavsiye edilen isi transfer katsayisi uygun olmayan, kompleks bir yapı olan Üniversite binasi örnek olarak seçilmiştir. Örnek bina, Balıkesir Üniversitesi kampüsünde bulunan Fen-Edebiyat Fakültesi binasıdır. Örnek bina; derslikler, ofis odaları, kantin, arşiv, laboratuvarlar, depolar, çeşitli kullanım alanları ve ısı merkezi gibi çok farklı bölümlerden oluşmaktadır. Bina 1994 yılında inşa edilmiştir. Örnek bina için Türk Yalıtım Standardı TS 825'te yapı kabuğu için tavsiye edilen ısı transfer katsayılarına bağlı olarak EnergyPlus simülasyonu kullanılarak yenileme yapılmasının enerji tüketimine etkisi araştırılmıştır. Bunun için şu an mevcut olan ve dört farklı senaryo üzerinde analizler ve hesaplamalar yapılmıştır. Bu seneryalorda, sadece dış duvara, sadece döşemeye, sadece tavana ve sadece pencereye TS 825 göre tavsiye edilen yapı kabuğu ısı transfer katsayısı uygunmıştır. Bu seneryolara göre hem ısıtma ve hem de soğutma dönemindeki enerji tüketimi araştırılmıştır. Örnek Fen Edebiyat Fakültesi Üniversite binasında, ısıtma dönemi olan kış aylarında doğal gaz ve soğutma dönemi olan yaz aylarında elektrik tüketilmektedir. Binanın ısı merkezinde ısıtma için doğal gaz tüketen merkezi sistem kazan ile ekipmanları ve soğutma için dış ortamda hava soğutmalı chiller ve iç ortamda chiller ekipmanları bulunmaktadır. Calısma ile kompleks Üniversite binalarındaki herbir yapı kabuğu elemanındaki iyileştirilmeler veya revizyon ile tüm binanın enerji tüketimine etki oranı tespit edilecektir. Kompleks Üniversite yapılarının enerji tüketiminde en etkili yapı kabuğu araştırılacaktır.

Anahtar Kelimeler: Üniversite Binaları enerji tüketimi, yapı kabuğu etkisi, TS 825, EnergyPlus.

EFFECT OF BUILDING SHELL ENVELOPES ON ENERGY CONSUMPTION OF COMPLEX UNIVERSITY BUILDINGS

ABSTRACT

In this study, the university building, which has a complex structure, was selected as a case study. This building was last renovated in 2013 in our country and has a heat transfer coefficient that does not comply with the insulation standard TS 825. The selected building is the Faculty of Arts and Sciences at Balıkesir University. It consists of various sections, including classrooms, offices, a canteen, archives, laboratories, storage areas, multi-purpose spaces, and a heating center. Constructed in 1994, the building's energy consumption was analyzed using the EnergyPlus simulation, based on the heat transfer coefficients recommended for the building envelope in the Turkish Insulation Standard TS 825. For this purpose, analyses and calculations were conducted on four different scenarios based on the current conditions. In these scenarios, compliance with the heat transfer coefficient recommended by TS 825 was examined separately for the exterior walls, floors, ceilings, and windows.



Energy consumption was evaluated during both the heating and cooling periods for each scenario. Specifically, in the Faculty of Arts and Sciences building, natural gas is used for heating during the winter months, while electricity is consumed for cooling during the summer months. The building's heating system includes a central boiler that operates on natural gas, as well as an air-cooled chiller for external cooling and additional chiller equipment for internal cooling. This study aims to determine the impact of improvements or modifications to each building envelope component in complex university buildings and assess their effect on the overall energy consumption of the structure. Furthermore, it seeks to identify the most influential building envelope element in the energy consumption of such buildings.

Keywords: University Buildings energy consumption, effect of building envelope, TS 825, EnergyPlus.

INTRODUCTION

Energy efficiency and sustainability are becoming increasingly critical in today's construction sector [1]. The growing global energy demand, the depletion risk of fossil fuels, and climate change have accelerated efforts to enhance the energy performance of buildings. Large and complex buildings, in particular, significantly impact both the environment and the economy due to their high energy consumption [2]. To minimize buildings' energy needs and promote sustainable construction, optimizing the thermal insulation properties of the building envelope is essential. The building envelope, a key factor influencing a building's energy performance, comprises components such as external walls, roofs, floors, windows, and doors. Inadequate insulation or non-compliance with established standards can lead to excessive energy losses, increased operational costs, and adverse environmental effects [3]. Turkey's TS 825 Thermal Insulation Standard [4] mandates that building envelopes adhere to specific heat transfer coefficients. However, a substantial portion of existing buildings fails to fully meet these standards, resulting in considerable energy losses and increased consumption [5-8].

The aim of this study is to investigate the impact of renovation on the energy consumption of the Faculty of Arts and Sciences building at Balıkesir University, a complex structure built in 1994. The analysis focuses on both the heating and cooling periods, using EnergyPlus simulations based on the heat transfer coefficients recommended in the Turkish Insulation Standard TS 825, last updated in 2013 [5,9,10]. For this purpose, analyses and calculations were conducted for four different scenarios, each considering heat transfer coefficient modifications for only one building envelope component: the external wall, floor, ceiling, or window. During the winter months (heating period), the building consumes natural gas, while electricity is used in the summer months (cooling period). Additionally, electricity is consumed for HVAC operations throughout both the heating and cooling periods. As a result, this study evaluates the impact of improvements or modifications in individual building envelope elements on the overall energy consumption of complex university buildings during heating and cooling periods.

MATERIAL AND METHOD

In this study, the Balıkesir University Faculty of Arts and Sciences building serves as a case study. The building features a central boiler system and equipment that consume natural gas for heating, while cooling is provided by an air-cooled chiller located outside and additional chiller equipment inside [11-13]. The building envelope components of the Faculty of Arts and Sciences building, used in the EnergyPlus simulation, are presented in Table 1. Energy consumption during the heating and cooling periods was analyzed using EnergyPlus simulations for the selected building [14-16].

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Table 1. Building envelope properties and	Table 1. Building envelope properties and layers [4, 17-18]						
Component	Thickness (mm)						
External wall							
Cement mortar external plaster	30						
Vertical perforated brick	190						
Cement mortar internal plaster	20						
Roof							
Polymer bitumen waterproofing membrane	6						
Primer	0.005						
Slope concrete	50						
Floor concrete	120						
Cement mortar plaster	20						
Ground-Floor							
Ceramic floor tile	15						
Leveling concrete + mortar	60						
Waterproofing membrane	3						
Lean concrete	100						
Sand	35						
Blockage	150						
Window (U value; 2.708 W/m ² K)							
Glass	6						
Air gap	13						
Glass	6						

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RESULTS AND DISCUSSIONS

The energy consumption of the sample building during the heating period (including natural gas and electricity for HVAC) was determined to range between 33,128 and 749,323 kWh, while the cooling period (including electricity and electricity for HVAC) ranged between 42,275 and 60,284 kWh. When the building envelope's heat transfer coefficient, as recommended in TS 825, was modified, it was observed that only external wall insulation resulted in an energy consumption of 31,363–661,412 kWh for the heating period and 35,058–50,532 kWh for the cooling period.

For other insulation scenarios, energy consumption varied as follows:

With only ceiling insulation, it ranged between 22,212–564,733 kWh during the heating period and 24,773–39,579 kWh during the cooling period.

With only floor insulation, it ranged between 33,128-729,221 kWh during the heating period and 39,333–56,731 kWh during the cooling period.

With window replacement, it ranged between 33,128–705,035 kWh during the heating period and 38,081–55,027 kWh during the cooling period.

All monthly heating period energy consumption values are presented in Figure 1, while cooling period energy consumption values are provided in Figure 2. The total energy consumption for both heating and cooling periods across all months (including natural gas and electricity for HVAC in the heating period and electricity for HVAC in the cooling period) is detailed in Table 4.

Table 1 presents the heat transfer coefficient (U) values for the TS 825 2nd Region, which includes Balıkesir, where the sample building is located. Table 2 displays the energy consumption for heating and cooling based on the existing building envelope conditions.



When the building envelope heat transfer coefficient was modified according to TS 825 recommendations, reductions in energy consumption were observed:

• External wall insulation resulted in a 5-12% decrease for the heating period and a 16-17% decrease for the cooling period.

• Ceiling insulation led to a 24–33% reduction in the heating period and a 34–41% reduction in the cooling period.

• Floor insulation achieved a 2-3% decrease in the heating period and a 6-7% decrease in the cooling period.

• Window replacement resulted in a 5-6% reduction during the heating period and a 9-10% reduction during the cooling period.

Table 3 summarizes the percentage change in energy consumption for heating and cooling periods under four different building envelope scenarios.

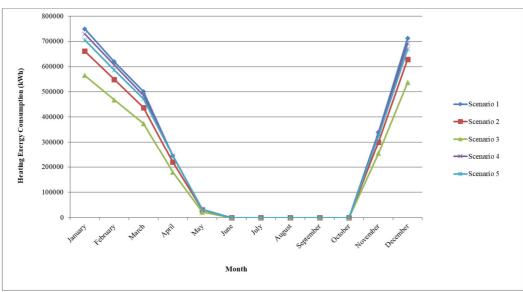


Figure 1. Heating period energy consumption of the sample building

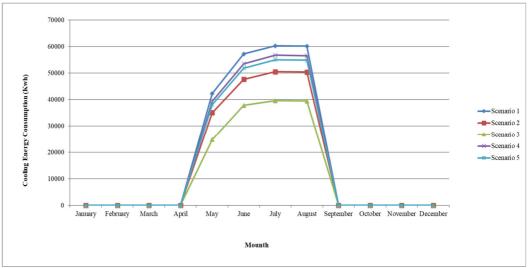


Figure 2. Cooling period energy consumption of the sample building



Table 1. TS 825 Building Envelope Heat Transfer Coefficient (U) values for
2nd Region (W/m².K) [4]

External wall	Ceiling	Ground (Floor)	Windows
0.57	0.38	0.57	1.8

Table 2. Energy consumption for heating and cooling depending on the existing building envelope of the example building

	Cooling	Heating		
	(Natural gas +	(Electricty+	(Total)	
	HVAC)	HVAC)		
January	0	749323	749323	
February	0	619197	619197	
March	0	500852	500852	
April	0	244330	244330	
May	34640	40763	75403	
June	57223	0	57223	
July	60284	0	60284	
August	60149	0	60149	
September	0	0	0	
October	0	0	0	
November	0	338627	338627	
December	0	712332	712332	

Table 3. Change in energy consumption during the heating and cooling periods based on four different building envelope scenarios (%)

	External Insulation	Wall n	Ceiling I	nsulation	Floor Ins	ulation	Windows replacem	
Months	Change	Change	Change	Change	Change	Change	Change	Change
	for	for	for	for	for	for	for	for
	cooling	heating	cooling	heating	cooling	heating	cooling	heating
January		12		25		3		6
February		11		24		2		5
March		13		25		3		6
April		10		27				
May	17	5	41	33	7		10	
June	17		34		6		9	
July	16		34		6		9	
August	16		34		6		9	
November		12		25		2		5
December		12		25		3		6

Table 4. Heating and cooling period energy consumption values depending on four different building envelope scenarios

Aylar	1. ScenarioAylar(External wall insulation)		ation)	2. Scenario (Ceiling insulation)			3. Scenario (Ground insulation)			4. Scenario (Window replacement)		
	Cooling Period	Heating Period	Total	Cooling Period	Heating Period	Total	Cooling Period	Heating Period	Total	Cooling Period	Heating Period	Total
January	0	661412	661412	0	564733	564733	0	729221	729221	0	705035	705035
February	0	548663	548663	0	467852	467852	0	606359	606359	0	586528	586528
March	0	437182	437182	0	373744	373744	0	485709	485709	0	472148	472148
April	0	219463	219463	0	179549	179549	0	249208	249208	0	246709	246709
May	28831.5	37589.5	66421	19407.5	27576.5	46984	32177	44554	76731	31243.5	44587.5	75831
June	47649	0	47649	37808	0	37808	53532	0	53532	51865	0	51865
July	50532	0	50532	39579	0	39579	56731	0	56731	55027	0	55027
August	50382	0	50382	39461	0	39461	56587	0	56587	54891	0	54891
September	0	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0	0	0
November	0	299657	299657	0	253961	253961	0	331019	331019	0	323119	323119
December	0	628954	628954	0	536935	536935	0	692645	692645	0	669086	669086

CONCLUSIONS

For the sample complex university building, the highest natural gas and HVAC electricity consumption during the heating period was observed in January, followed by December, with the lowest consumption recorded in May. During the cooling period, the highest electricity and HVAC electricity consumption occurred in July, followed by December, with the lowest in May. It was observed that both heating and cooling were required for the sample building in May.

Based on the heat transfer coefficient recommended for the building envelope according to TS 825, the lowest energy consumption during the heating period was recorded with ceiling insulation (564,733 kWh), followed by external wall insulation (661,412 kWh), window replacement (705,035 kWh), and the highest consumption with floor insulation (729,221 kWh). It was determined that ceiling insulation provided the highest heating energy savings, while floor insulation resulted in the lowest savings.

For the cooling period, the lowest energy consumption was observed with ceiling insulation (39,579 kWh), followed by external wall insulation (50,532 kWh), window replacement (55,027 kWh), and the highest consumption with floor insulation (56,731 kWh). The results indicate that ceiling insulation achieved the highest cooling energy savings, whereas floor insulation provided the least savings.

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KOMPLEKS ÜNİVERSİTE YAPILARININ ENERJİ TÜKETİMİNE BAĞLI YAŞAM ÇEVRİMİ EMİSYON ANALİZİ

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ÖZET

Calısmada, farklı yönlerdeki yüzde %13.6 ile %38.02 arasında değişen pencere/duvar oranları ve toplam 15986 m² toplam dış duvar alanı ile 4796 m² dış pencere alanı olan derslikler, ofisler, laboratuvarlar, depolar ve farklı kullanımı olan bölümlere sahip kompleks Üniversite binasında ısıtma ve soğutma döenmi için emisyon analizi yapılmıştır. Örnek kompleks üniversite binasının kuzey yönünde; 2286 m² dış duvar ve 311 m² pencere alanı, doğu yönünde 5707 m² duvar alanı ve 2170 m² pencere alanı, güney yönünde 2286 m² duvar alanı ve 346 m² pencere alanı, batı yönünde 5707 m² dış duvar alanı ve 1969 m² pencere alanına sahiptir. Bina, kış dönemi olan ısıtma döneminde doğal gaz ve yaz döenminde elektrik tüketimine bağlı olarak meydana gelen karbondioksit (CO₂) emisyonu için on yıllık dönemdeki yaşam çevrimi emisyon analizi (LCEA) yapılmıştır. Örnek kompleks binası, 1994 yılında hizmete başlayan, Balıkesir Üniversitesi Fen-Edebiyat Fakültesi binasıdır. Örnek bina için ülkemiz yalıtım standardı olan, 2013 revize edilen TS 825'te yapı kabuğu olan dış duvar ve pencere için tavsiye edilen ısı transfer katsayılarına bağlı olarak EnergyPlus simülasyonları yapılmıştır. Bu simülasyonlara bağlı örnek kompleks üniversite binasının ısıtma ve soğutma dönemi için enerji tüketimi tespit edilmiştir. Binanın ısı merkezinde ısıtma için doğal gaz tüketen kazanlar ve soğutma için hava soğutmal chillerler bulunmaktadır. Enerji etkin güçlendirme için yaşam döngüsü emisyon analizi yapılmıştır. Çalışmada, örnek binada dış duvar, taban, tavan (döşeme) ve pencere için tavsiye edilen ısı transfer katsayısına göre yenileme yapılması durumunda, on yıllık dönem için iklim değişikliğine etkisini ve sürdürülebilir çevre için hem ısıtma hem de soğutma dönemi için yaşam çevrimi karbondioksit sera gazı emisyonu değisimini incelenmistir.

Anahtar Kelimeler: Üniversite Binaları enerji tüketimi, pencer duvar ısı transfer katsayısı, TS 825, EnergyPlus, yakıt emisyonu, yaşam çevrimi emisyon analizi (LCEA)

LIFE CYCLE EMISSION ANALYSIS DEPENDING ON ENERGY CONSUMPTION OF COMPLEX UNIVERSITY BUILDINGS

ABSTRACT

In the study, an emission analysis was conducted for the heating and cooling periods of the complex university building with classrooms, offices, laboratories, storage areas, and sections with different uses, with window/wall ratios ranging from 13.6% to 38.02% in different directions and a total external wall area of 15,986 m² and a total external window area of 4,796 m². The reference complex university building has 2,286 m² of external wall and 311 m² of window area in the north direction, 5,707 m² of wall area and 2,170 m² of window area in the east direction, 2,286 m² of wall area and 346 m² of window area in the south direction, and 5,707 m² of external wall area and 1,969 m² of window area in the west direction.



A life cycle emission analysis was conducted for the carbon dioxide (CO₂) emissions that occur due to natural gas consumption during the heating period and electric consumption during the cooling period, which is the winter season, over a ten-year period. The reference complex building is the Balıkesir University Faculty of Arts and Sciences building, which started service in 1994. EnergyPlus simulations were performed for the reference building based on the heat transfer coefficients recommended for the external wall, floor (ground), ceiling and glazing, which is the insulation standard of our country, TS 825, revised in 2013. The energy consumption of the reference complex university building was determined based on these simulations. There is a boiler that consumes natural gas to heat the center of the building. A life cycle emission analysis was performed for energy-efficient retrofitting. In the study, in case of renovation according to the heat transfer coefficient recommended for the external wall and window in the reference building, the effect on climate change over a ten-year period and the change in life cycle carbon dioxide (CO₂) greenhouse gas emissions for a sustainable environment were examined.

Keywords: University Buildings energy consumption, window wall heat transfer coefficient, TS 825, EnergyPlus, fuel emission, life cycle emission analysis

INTRODUCTION

Approximately 40% of the fossil energy sources consumed worldwide are used in buildings to meet heating, cooling, and lighting needs. This highlights the significance of energy-efficient consumption in buildings. Renovations are required to enhance energy efficiency in existing buildings. In order to achieve energy-efficient retrofitting, it is essential to first improve the characteristics of the building envelope. This involves considering thermal insulation options for external walls, roofs, and floors, as well as different glazing properties for windows [1].

Due to advancements in technology and the increasing demand for comfortable living spaces, there has been a rise in building stock expansion, destruction of green areas, and increased fossil energy consumption. This, in turn, has led to environmental and energy-related issues such as air pollution, global warming, and the depletion of natural resources. Greenhouse gas emissions resulting from the use of fossil energy sources constitute one of the primary causes of global warming [1,2].

Through the life cycle cost (LCC) analysis method, the projected cost variation is calculated by multiplying the initial investment costs of building envelope materials with the present value factor of maintenance and energy costs over the building's lifetime. While the life cycle performance of residential buildings is predominantly assessed in terms of life cycle cost or savings, the life cycle greenhouse gas emissions (LCEA) and life cycle energy (LCEA) analyses are also of considerable importance. When calculating the life cycle greenhouse gas emissions for various energy-efficient building improvement scenarios, the impact of inflation on greenhouse gas emissions should be taken into account. Key parameters in this context include the unit cost of energy sources, unit greenhouse gas emissions, interest rate, and the impact of inflation on greenhouse gas emissions. Additionally, the combustion efficiency of the fuel serving as the energy source, energy inflation, and the building's lifespan are other critical parameters [2-5].

The objective of this study is to conduct an emission analysis based on energy consumption variations through energy-efficient retrofitting of the Faculty of Science and Letters building at Balıkesir University. The building complex, covering a total external wall area of 15,986 m², an external window area of 4,796 m², and a total floor area of 31,000 m², includes classrooms, offices, laboratories, storage areas, and various other functional spaces. Using EnergyPlus simulations, the study examines energy consumption changes for both heating and cooling periods.



A life cycle emission analysis (LCEA) was performed over a ten-year period to assess CO₂ emissions arising from natural gas consumption during the heating season (winter) and electricity consumption during the cooling season (summer) [6-9].

For the selected building, energy consumption was determined through EnergyPlus simulations based on the recommended heat transfer coefficients specified in the revised 2013 version of TS 825, the national insulation standard. Energy consumption during heating and cooling seasons was evaluated for both the current condition and a scenario where the entire building envelope— comprising external walls, roof, floor, and windows—is retrofitted for energy efficiency. The study further conducts a life cycle emission analysis for carbon dioxide emissions over a ten-year period, accounting for the energy-efficient renovation of the entire building envelope and assessing the resulting variations [9,10].



Figure 1. General view of the reference university building

MATERIAL AND METHOD

In this study, a life cycle emission analysis was conducted for the heating and cooling periods of the Balıkesir University Faculty of Arts and Sciences building. The building, originally put into service in 1994 and last renovated in 2013, was analyzed using the EnergyPlus simulation program. The analysis considered both the current state and the recommended building envelope heat transfer coefficients according to TS 825, assessing carbon dioxide (CO₂) emissions based on changes in energy consumption. The Faculty of Arts and Sciences complex has an external wall area of 2,286 m² and a window area of 311 m² on the north side, 5,707 m² of wall area and 2,170 m² of window area on the east side, 2,286 m² of wall area and 346 m² of window area on the south side, and 5,707 m² of external wall area with 1,969 m² of window area on the west side. Additional details of the building's characteristics are provided in Table 1.

Table 2 presents the heat transfer coefficients recommended for the external walls, ceiling, floor, and windows of the Balıkesir University Faculty of Arts and Sciences building in accordance with the 2013 revision of TS 825 (the national insulation standard) [11,12]. Energy consumption and corresponding emission analyses were carried out using EnergyPlus simulations, incorporating energy-efficient retrofitting measures based on TS 825 for the reference university complex.



This study examined the changes in life cycle CO_2 greenhouse gas emissions over a ten-year period, considering both natural gas and electricity consumption, under a renovation scenario that applies the heat transfer coefficients recommended for the building envelope by TS 825. Equation (1) was used for this analysis.

Table 1. Example Building external wall and window areas								
	Total	North	East	South	West			
External wall	15984.83	2285.80	5706.62	2285.80	5706.62			
Glazing area (m ²)	4794.83	310.53	2170.07	345.73	1968.51			
Window to wall ratio (%)	30.00	13.59	38.03	15.12	34.50			

Table 2. Building envelope heat transfer coefficient values for 2nd zone according to TS 825	
$(W/m^2 K)$ [9 13 14]	

External wall	Ceiling	Ground (floor)	Glazing	
0.57	0.38	0.57	1.8	

The equation for life cycle carbon dioxide emission change (LCEA) is [3-5, 16-18],

$$LCEA = c_{fuel} \sum_{t=1}^{N} \frac{Q_{year}}{(1+i_{fuel})^{t} \eta}$$
(1)

Here, Q_{year} is yearly energy consumption, *Cfuel* denotes the unit greenhouse gas emissions, with values assumed to be 0.356 kg-CO₂eq/kWh for electricity and 0.202 kg-CO₂eq/kWh for natural gas. The parameter i_{fuel} represents the interest rate, while *isg* signifies the temporal valuation of greenhouse gas emissions, commonly referred to as impact inflation. The combustion efficiency of energy sources is denoted by η , whereas *N* corresponds to the building's operational lifespan, set at 10 years. Within this study, for the life-cycle greenhouse gas emissions (LCG) associated with electricity consumption, a heating system efficiency of 0.99 and an energy inflation rate of 3% have been adopted. Similarly, for natural gas consumption, a heating system efficiency of 0.93 and an energy inflation rate of 3% have been assumed [1,2,21-23].

RESULTS AND DISCUSSIONS

In this study, the energy consumption of the Balıkesir University Faculty of Arts and Sciences building used as a reference building during the heating (natural gas) and cooling (electricity) periods, including HVAC, was determined based on its current condition using the EnergyPlus simulation program. These values are presented in Table 1.

Table 2 provides the heating and cooling energy consumption results (including HVAC electricity consumption) for the reference building after renovations were applied to the building envelope components (external walls, ceiling, floor, and windows) according to TS 825 standards for the 2nd climate region, as analyzed using the EnergyPlus simulation program.

Table 3 presents the carbon dioxide (CO_2) emissions and long-term life cycle emission analysis (LCEA) values related to heating and cooling energy consumption for the reference building when all building envelope elements are renovated, calculated using equation (1).



Table 4 shows the carbon dioxide (CO_2) emissions due to heating and cooling energy consumption for the reference building after full renovation of the building envelope, along with the reduction rate (%) determined through the long-term life cycle emission analysis (LCEA).

	Cooling Energy	Heating Energy	
	(Electricty + HVAC cons.)	(Natural gas + HVAC	Total
		cons.)	
January	0	749323	749323
February	0	619197	619197
March	0	500852	500852
April	0	244330	244330
May	34640	40763	75403
June	57223	0	57223
July	60284	0	60284
August	60149	0	60149
September	0	0	0
October	0	0	0
November	0	338627	338627
December	0	712332	712332

Table 1. Energy consumption for heating and cooling depending on the existing building envelope of the example building

Table 2. Heating and cooling energy consumption for the reference building when all building envelope elements (external walls, ceiling, floor and windows) are renewed

Months	Cooling	HVAC	Heating Energy	Cooling +	Heating +	Total
	Energy	Energy	(Natural gas)	HVAC	HVAC	Energy
	(Electricity)	(Electricity)	Cons.	Energy (Electricity)	Energy (Natural	Cons.
	Cons.	Cons.		Cons.	gas) Cons.	
January	0	20076	418009	0	438085	438085
February	0	18133	357165	0	375298	375298
March	0	20076	274951	0	295027	295027
April	0	19428	111084	0	130512	130512
May	7631	20076	8292	21684	14315	35999
June	9927	19451	0	29378	0	29378
July	10556	20191	0	30747	0	30747
August	10508	20155	0	30663	0	30663
September	0	0	0	0	0	0
October	0	0	0	0	0	0
November	0	19428	182210	0	201638	201638
December	0	20076	415018	0	435094	435094



Table 3. Carbon dioxide emission (CO2) and long-term life cycle emission analysis (LCEA) values related to heating and cooling energy consumption for the reference building when all building

Months	Cooling	Heating	Cooling	Heating
	(Electricity +	(Natural gas +	(Electricity +	(Natural gas +
	HVAC)	HVAC)	HVAC) LCEA	HVAC) LCEA
January	0	88493	0	110616
February	0	75810	0	94763
March	0	59595	0	74494
April	0	26363	0	32954
May	7720	2892	10265	3614
June	10459	0	13908	0
July	10946	0	14556	0
August	10916	0	14516	0
September	0	0	0	0
October	0	0	0	0
November	0	40731	0	50914
December	0	87889	0	109861

Table 4. Carbon dioxide emission (CO2) due to heating and cooling energy consumption for the reference building when all building envelope elements are renovated and the reduction rate (%) in the long-term life cycle emission analysis (LCEA)

Months	Cooling (Electricity + HVAC) energy cons.	Heating (Natural gas + HVAC) energy cons.	Reduction
January	0	58	42
February	0	61	39
March	0	59	41
April	0	53	47
May	63	35	52
June	51	0	49
July	51	0	49
August	51	0	49
September	0	0	0
October	0	0	0
November	0	60	40
December	0	61	39

CONCLUSIONS

In this study, changes in energy consumption during the cooling period (including HVAC electricity consumption), ranging from 34,640 to 60,284 kWh, and natural gas consumption during the heating period (including HVAC electricity consumption), ranging from 40,763 to 749,323 kWh, were determined for the Balıkesir University Faculty of Arts and Sciences building using the EnergyPlus simulation program based on its current state.



When an energy-efficient renovation was applied to the building envelope, including the external walls, ceiling, floor, and windows following the heat transfer coefficients recommended for the 2nd climate zone in the 2013 revision of TS 825 (Balıkesir province is in the 2nd climate zone), the energy consumption was re-analyzed using the EnergyPlus simulation program.

According to the results, carbon dioxide (CO₂) emissions from electricity consumption (including HVAC electricity consumption) during the cooling period were found to be between 7,720 and 10,946 kg. Meanwhile, CO₂ emissions from natural gas consumption (including HVAC electricity consumption) during the heating period ranged from 2,892 to 88,493 kg.

As part of the life cycle emission analysis (LCEA) conducted over a ten-year period, the emission changes were calculated to be between 10,265 and 14,556 kg for the cooling period and between 3,614 and 110,616 kg for the heating period.

The EnergyPlus simulation analysis revealed that implementing an energy-efficient renovation of the sample building in accordance with TS 825 led to a reduction of 51-63% in energy consumption during the cooling period, 35-61% during the heating period, and 39-52% over the entire year in terms of energy use, carbon dioxide emissions, and life cycle emissions.

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SYNTHESIS OF 4,4-DIMETHYL-2,6-BIS(TRICHLOROMETHYL)-1,4-DIHYDRO-1,3,5-TRIAZINE

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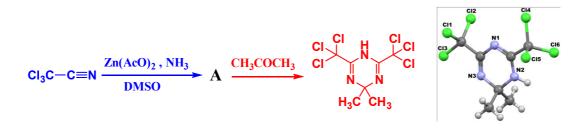
ABSTRACT

The acetonitrile derivative was reacted with CHCl2CN and a new product was obtained. Thus, dissolving the obtained reaction product (A) in acetone led to the preparation of the 4,4-dimethyl-2,6-bis(trichloromethyl)- 1,4-dihydro-1,3,5-triazine. As can be seen from its molecular structure, the presence of a heminal dimethyl fragment in the 4,4 position of the 4,4-dimethyl-2,6-bis(trichloromethyl)-1,4-dihydro-1,3,5-triazine compound gives reason to say that the structure of compound A corresponds to 2,2-dibromo-N-(2,2-dichloro-1-iminoethyl) acetimidamide in the simplest case, without taking Zn into account.



Thus, the presence of a heminal dimethyl fragment in the compound 4,4-dimethyl-2,6-bis(trichloromethyl)-1,4-dihydro-1,3,5-triazine can be obtained only in one case, from the reaction of the imine groups in the compound 2,2-dichloro-N-(2,2-dibromo-1-iminoethyl) acetimidamide with acetone.

Keywords: Triazine derivative, acetimidamide, X-Ray investigations



MAPPING OF BIOAVAILABILITY RADAR OF 4,4-DIMETHYL-2,6-BIS(TRICHLOROMETHYL)-1,4-DIHYDRO-1,3,5-TRIAZINE

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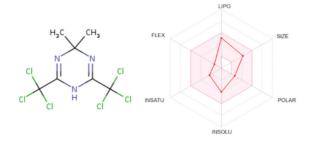
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ABSTRACT

Nitrogen-containing heterocyclic compounds are one of the main goals of organic and medicinal chemistry. Thus, in recent decades, there has been a lot of literature on the advantages of using this type of compounds. Some of them are related to triazines, which means a 6-membered benzene ring in which 3 carbon atoms are replaced by nitrogen. Currently, many triazine-containing antibiotics are used. Taking all this into account, 4,4-dimethyl-2,6-bis(trichloromethyl)-1,4-dihydro-1,3,5-triazin was synthesized and its structure was confirmed by modern physical research methods (mass, RQA). In silico studies were conducted taking into account many biological properties of triazine derivatives. For this, Swiss Targeted Prediction and Swiss ADME programs were used. The pharmacokinetic properties of the compound were studied using this program. The lipophilicity, size, polarity, solubility, unsaturation and elasticity of the compounds are studied.



The six descriptors mentioned (SIZE, LIPO, INSATU, POLAR, INSOLU, FLEX) show us that molecules present in the pink region of the radar have good bioavailability properties in the body. It should be noted that our compound does not deviate from the pink zone at all. **Keywords:** Triazine derivatives, insilico investigations, bioavailability radar



ETİL KLOROFORMAT ile MODİFİYE EDİLMİŞ POLİPROPİLEN LİFLERİN SENTEZİ, KARAKTERİZASYONU VE ÇİMENTOLU SİSTEMLERDE PERFORMANS DEĞERLENDİRMESİ

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ÖZET

Polipropilen (PP) lifleri, düsük yüzey enerjileri ve hidrofobik özellikleri nedeniyle cimentolu sistemlerde matrisle aderansı zayıf olmakta ve işlenebilirlik sorunlarına yol açmaktadır. Bu durum, çimentolu sistemlerin mekanik özelliklerini olumsuz etkileyebilir. Bu çalışmada, 12 mm uzunluğunda atık PP liflerinin yüzey özelliklerini iyileştirmek amacıyla etil kloroformat (EtOCOCI) kullanılarak kimyasal klorlama işlemi gerçekleştirilmiştir. Klorlama işlemi, PP liflerinin yüzeyine klor atomlarının bağlanmasını sağlayarak yüzey kimyasını değiştirir ve liflerin yüzey enerjisini artırır. Bu modifikasyon, liflerin çimento matrisi ile daha iyi aderans sağlamasına ve işlenebilirlik özelliklerinin iyileşmesine yardımcı olmuştur. Klorlama süreci sırasında optimum reaksiyon koşulları belirlenmiş ve modifiye lifler, Fourier dönüşümlü spektroskopisi (FT-IR) ve taramalı elektron mikroskobu (SEM) kızılötesi gibi karakterizasyon teknikleriyle analiz edilmiştir. FT-IR analizleri, yüzeydeki fonksiyonel grup değişimlerini doğrularken, SEM görüntüleri yüzey morfolojisindeki değişiklikleri ortaya koymustur. Klorlama islemi uygulanan ve uygulanmayan PP lifleri kullanılarak üretilen karışımlar karşılaştırıldığında, modifiye PP liflerinin karışımlarda daha homojen dağıldığı ve modifiye PP lifli numunelerin matris-lif aderansının güçlenmesinin sonucunda eğilme dayanımlarının iyileştiği, ancak basınç dayanımları üzerinde önemli bir değişim görülmemiştir.

Anahtar kelimeler: Polipropilen lif, etil kloroformat, çimentolu sistemler, yüzey modifikasyonu, basınç dayanımı, eğilme dayanımı.

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SYNTHESIS, CHARACTERISATION AND PERFORMANCE EVALUATION OF POLYPROPYLENE FIBRES MODIFIED WITH ETHYL CHLOROFORMATE IN CEMENTITIOUS SYSTEMS

ABSTRACT

Polypropylene (PP) fibres cause poor adhesion and wettability problems in cementitious systems and other application areas due to their low surface energy and hydrophobic properties. In this study, a chemical chlorination process using ethyl chloroformate (EtOCOCI) was carried out to improve the surface properties of PP fibres. The chlorination process modified the surface chemistry of PP fibres by binding chlorine atoms to the surface and increased the surface energy of the fibres. This modification provided better adherence of the fibres with the cement matrix and improved wettability properties. Optimum reaction conditions were determined during the modification process and the modified fibres obtained were analysed by characterisation techniques such as Fourier transform infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM) measurements. FT-IR analyses confirmed functional group changes on the surface, while SEM images revealed changes in surface morphology. Mechanical tests in cementitious systems proved that the modified PP fibres are more homogeneously distributed with the cement matrix and the interfacial bond is strengthened. This made a significant contribution to the improvement of crack control, impact strength and mechanical performance. It is predicted that PP fibres modified with ethyl chloroformate can provide performance enhancement in areas such as composite materials, textile coatings and biomedical applications. This study brings a new approach to polymer surface modification techniques and contributes to the literature in the fields of civil engineering and chemistry. This method for improving the performance of fibre reinforced composites, especially in cementitious systems, is a guide for future research in the field of building materials.

Keywords: Polypropylene, ethyl chloroformate, cementitious systems, surface modification, mechanical strength.

GİRİŞ

Cimento esaslı malzemeler, yüksek basınç dayanımına sahip olsalar da çekme ve eğilme yükleri altında kırılganlık gösterirler. Bu sorunun üstesinden gelmek için beton içerisine çeşitli lifler eklenerek fiber takviyeli çimento esaslı kompozitler (FRCC) geliştirilmiştir (Vandewalle, 2007). Lifler, çatlak oluşumunu ve yayılmasını kontrol ederek betonun süneklik, tokluk ve cekme dayanımını artırmaktadır (Yao, vd., 2003). Özellikle polipropilen (PP) lifler, kimyasal olarak kararlı yapıları nedeniyle tercih edilmektedir. Ancak, hidrofobik yüzeyleri nedeniyle çimento matrisi ile arayüzey bağları zayıftır ve bu durum betonun mekanik performansını sınırlayabilir (Xu, vd., 2017). PP liflerinin çimento matrisine olan bağlanma performansını artırmak amacıyla cesitli yüzey modifikasyon yöntemleri geliştirilmiştir. Fiziksel yöntemler arasında lif yüzeyinde pürüzlülük oluşturmak için mekanik oyuklar açılması yer alırken, kimyasal yöntemlerde polivinil asetat veya asit-dikromat gibi maddelerle işlem uygulanmaktadır. Bu işlemler, liflerin yüzey enerjisini artırarak çimento ile daha iyi bir bağ oluşmasını sağlar (Toutanji, 1999). Bununla birlikte, nano malzemelerle yapılan kaplamaların çimento matrisine kimyasal bağlanma sağlamadığı tespit edilmiştir. Son yıllarda, parafinin faz değişim süreci kullanılarak PP liflerine nano kalsiyum karbonat kaplanması yöntemi geliştirilmiştir.



Nano kalsiyum karbonat, hem çimento hidratasyon ürünlerinin oluşumunu teşvik eden kristal yapısı sunmakta hem de etrenjiti stabilize etmektedir. Yapılan çekme ve eğilme testleri, bu yöntemin çimento-lif ara yüzey bağını güçlendirdiğini ve betonun mekanik özelliklerini iyileştirdiğini göstermektedir (Singh, vd., 2004; Feng, vd., 2021).

Ma ve arkadaşlarının (2020) çalışmasında, PP liflerin yüzey modifikasyonu, PP lif takviyeli yoğunlaştırılmış hazırlanması amacıyla beton kompozitlerin HNO₃ kullanılarak gerçekleştirilmiştir. Bu modifikasyon işlemi, PP liflerin yüzeyinde oksidasyon reaksiyonu yoluyla gerçekleştirilmiş ve bu reaksiyonun etkisi, PP lif takviyeli beton kompozitlerin mekanik testleri ile değerlendirilmiştir. FTIR analizi sonucunda, 3300 cm⁻¹ dalga sayısında O-H bağının ve 1720 cm⁻¹ dalga sayısında C=O bağının gerilme titreşimlerinin gözlemlenmesi, modifiye edilmiş polipropilen liflerin yüzeyinde oksijen içeren fonksiyonel grupların oluştuğunu göstermektedir. Ayrıca, modifiye edilmiş polipropilen liflerin temaş açıları, işlem görmemiş liflere kıyasla (112°) önemli ölçüde azalarak yaklaşık 81°'ye düşmüştür. SEM analizleri, HNO3 ile modifiye edilmiş polipropilen liflerin yüzeyinde belirgin bir korozyon etkisi olduğunu ve yüzeyin oldukça pürüzlü hale geldiğini, ayrıca yüzey yakınında gözenekli bir yapının oluştuğunu ortaya koymaktadır. Sonuç olarak, modifiye edilmiş PP lif takviyeli çimentolu sistemlerin mekanik özellikleri, işlem görmemiş PP liflere kıyasla %11,5 oranında artış göstermiştir.

Lu ve ekibinin (2021) çalışmasında, siltli zeminin düşük nem içeriği ve zayıf bağ yapısı nedeniyle temel mühendisliği için uygun olmadığı belirtilmiştir. Bu zeminin özelliklerini iyileştirmek amacıyla PP lif ve uçucu kül kullanılarak çimento ile modifiye edilmiş ve mekanik davranışı incelenmiştir. Çalışmada, farklı oranlarda çimento (%4-16), PP lif (%0-0.45) ve uçucu kül (%0-15) karışımları hazırlanmış ve 7, 14, 28 ve 60 günlük kür sürelerinde serbest basınç mukavemeti (UCS), SEM ve XRD analizleri yapılmıştır. Sonuçlara göre, çimento miktarı ve kür süresi arttıkça UCS değeri artmıştır. PP lif ve uçucu kül ilavesi ise UCS değerini önce artırmış, daha sonra azaltmıştır. Optimum karışım oranları %10 uçucu kül ve %0.15 PP lif olarak belirlenmiştir. Mikro yapı analizlerinde, C-S-H ve etrenjit gibi bileşiklerin oluştuğu ve zemin partiküllerini birbirine bağlayarak sıkı bir ağ yapısı oluşturduğu gözlemlenmiştir. XRD sonuçları, çimento ve kür süresinin mineral yapıyı daha fazla etkilediğini, uçucu külün etkisinin ise daha sınırlı olduğunu göstermiştir. Gerilme-şekil değiştirme eğrisi, elastik, plastik ve yumuşama aşamaları olarak üç bölümde incelenmiştir.

Yuan ve arkadaşlarının (2022) çalışmasında, Çin'in Kuzeybatı bölgesinde yaygın olarak kullanılan zeminin gevşek yapısı nedeniyle mühendislik gereksinimlerini karşılamadığı belirtilmiş ve bu sorunu çözmek için polipropilen lif uzunluğu (PPL), polipropilen lif içeriği (PPC), bentonit (B) ve cimento (C) gibi katkı maddelerinin etkileri incelenmistir. Taguchi yöntemi kullanılarak yapılan deneylerde, 6 mm PPL, %0,3 PPC, %3 B ve %8 C içeren PPBC lös karışımının en uygun koşullar sağladığı tespit edilmiştir. PPBC lös, kireç ile iyileştirilmiş lös ile karşılaştırıldığında hem serbest basınç mukavemeti (UCS) hem de geçirgenlik acısından daha üstün performans göstermistir. Mikroyapı analizleri (SEM, FTIR, NMR), kireçli lösün mukavemetinin C-S-H jelleri ile kimyasal olarak arttığını, PPBC lösün ise polipropilen liflerin fiziksel takviyesi ve çimentonun kimyasal etkileri ile iyileştiğini ortaya koymuştur. FTIR ve NMR sonuçları, PPBC lösün mekanik özelliklerindeki artışın bandı yoğunluğunun artması adsorpsivon ve gözenek hacminin azalmasından kaynaklandığını, kireçli lösün ise temel olarak gözenek azalmasından etkilendiğini göstermiştir.

Mukhametrakhimov ve ekibinin (2025) çalışmasında, alçı-çimento-puzolan bağlayıcı (GCPB) için kullanılan polifonksiyonel kompleks modifikatörün etkinliği incelenmiştir. Bu modifikatör, karışımın su ihtiyacını %35 oranında azaltırken, alçı-çimento-puzolan kompozitlerin (GPPC) eğilme mukavemetini %28 ve basınç mukavemetini ise %25 oranında artırmıştır. Çalışmada ayrıca, polipropilen (PP) liflerin GCPB'nin temel fizikomekanik özellikleri üzerindeki etkisi deneysel olarak araştırılmıştır. Yapılan çalışmalar, VSM-II-6 tipi PP liflerin kullanımının yüksek verimlilik sağladığını göstermiştir. Liflerin %1 hacimsel oranda kullanılmasıyla eğilme dayanımında %41,2 ve basınç dayanımında %20 artış elde edilmiştir. Bununla birlikte, 6 mm'den uzun liflerin kullanımı, heterojen bir yapı oluşumuna neden olduğu için beklenen sonuçları vermemiştir. Bu bulgular, PP liflerin GPPC'nin mekanik özelliklerini optimize etmede etkili bir yöntem olduğunu, fakat lif boyutunun önemini ortaya koymaktadır.

Haider ve ekibinin (2018) calısmasında, lif takviyeli betonun, icerisinde rastgele dağıtılmıs lifler içeren ve geliştirilmiş bir beton türü olduğu belirtilmiştir. Liflerin eklenmesiyle betonun mekanik özellikleri, özellikle basınç, eğilme ve çekme mukavemeti açısından iyileştirilmiştir. Ayrıca, lifler betonu daha dayanıklı ve daha düşük geçirgenlik özelliklerine sahip hale getirmiştir. Bu çalışma, polipropilen (PP) liflerin yüksek performanslı çimento ile kullanılarak betonun mekanik özelliklerinin geliştirilmesini amaçlamaktadır. Yedi farklı oranda polipropilen lif ve iki farklı oranda yüksek performanslı çimento kullanılmış, ayrıca herhangi bir katkı maddesi içermeyen normal beton numuneleri de karşılaştırma amacıyla hazırlanmıştır. Test sonuçları hem polipropilen liflerin hem de yüksek performanslı çimentonun birlikte kullanımının betonun özelliklerini önemli ölçüde iyileştirdiğini göstermiştir. Eğilme mukavemeti 2,7 MPa'dan 14,5 MPa'ya, çekme mukavemeti ise 1,9 MPa'dan 7 MPa'ya kadar artmıştır. Basınç mukavemeti ise polipropilen lifler ve yüksek performanslı çimento kullanımı sayesinde 30,1 MPa'dan 42,9 MPa'ya yükselmiştir. Yüksek performanslı çimento ve polipropilen lif içeren beton numuneleri, ilk yük boşaltması sonrasında bile ek yük döngülerine karsı veterli dayanım göstermiştir. Calısma, polipropilen liflerin ve yüksek performanslı çimentonun birlikte kullanımının betonun mekanik özelliklerini önemli ölçüde artırdığını ve betonun dayanıklılığını iyileştirdiğini ortaya koymaktadır.

PP liflerinin düşük yüzey enerjisi ve hidrofobik özellikleri, çimento matrisi ile aderansını sınırlandırmakta ve bu durum çimentolu sistemlerin mekanik performansını olumsuz etkilemektedir. Bu çalışmada bu sorunu aşmak için, ger dönüştürülmüş PP liflerinin yüzey kimyasını değiştirmek üzere etil kloroformat (EtOCOCl) kullanılarak kimyasal klorlama işlemi uygulanmıştır. Bu işlem, liflerin yüzeyine klor atomlarının bağlanmasını sağlayarak yüzey enerjisini artırmakta ve çimento matrisi ile daha iyi aderans yapmasını sağlamaktadır. Deney çalışmalar kapsamında yüzey modifikasyonu gerçekleştirilmiş PP liflerin çimentolu sistemlerin basınç ve eğilme dayanımlarına etkileri araştırılmıştır.

MATERYAL ve YÖNTEM

Malzeme

Çimento

Bu proje kapsamında harçta kullanılmak üzere TS EN197-1 standartlarına uygun, CEM I 42.5 R tipi çimento kullanılmıştır. Çimentoya ait fiziksel, kimyasal ve mekanik özellikler Tablo 1'de verilmiştir.

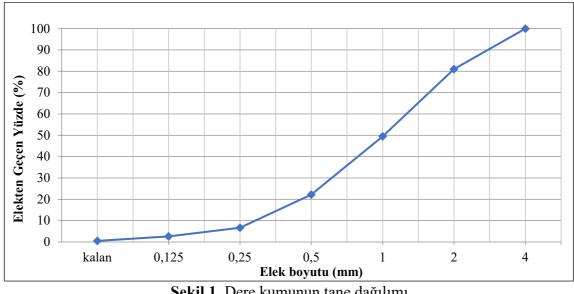
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Oksit (%)	Çimento	Fiziksel Özell	likler		
SiO ₂	18.86	Özgül Ağırlık		3.15	
Al_2O_3	5.71	İncelik			
Fe ₂ O ₃	3.09	Özgül yüzey (Özgül yüzey (Blaine, cm ² /g) 3		
CaO	62.70	0.045 mm elel	0.045 mm elekte kalıntı (%) 7.6		
MgO	1.16	Mekanik Öze	Mekanik Özellikleri		
SO ₃	2.39		1-günlük	14.7	
Na ₂ O+0,658 K ₂ O	0.92	Basınç	2-günlük	26.80	
Cl'	0.01	Dayanımı (MPa)	7-günlük	49.80	
Çözünmeyen kalıntı	0.32	(1 111 u)	28 günlük	58.5	
Kızdırma kaybı	3.20				
Serbest CaO	1.26				

fizilraal liimayaaal ya maltanilt özalliltlari

Agrega

Harç karışımlarının üretiminde 0-4 mm tane çapına sahip dere kumu agregası kullanılmıştır. Kullanılan agreganın gradasyon eğrisi Şekil 1'de gösterilmiştir. Agreganın TS EN 1097-6 standardına göre suya doygun yüzey kuru özgül ağırlığı 2,64 ve su emme kapasitesi %0,4 olarak ölçülmüştür.



Şekil 1. Dere kumunun tane dağılımı

Su Azaltıcı Katkı

Harç karışımlarda hedeflenen yayılma ve çökme değerlerini sağlamak için tek tip polikarboksilat esaslı yüksek oranda su azaltıcı katkı kullanılmıştır. Kullanılan su azaltıcı katkının üretici firma tarafından temin edilen bazı özellikleri Tablo 2'de verilmiştir.



Tablo 2. Su azaltıcı katkı kimyasal özellikleri			
Özellikler	Değerler		
Yoğunluğu (gr/cm ³)	1,073		
Kimyasal bileşiği	Polikarboksilat esaslı sıvı		
Katı madde oranı (%)	28,76		
Klor içeriği (% kütlece)	0,0618		
Alkali miktarı (% kütlece)	<u>≤</u> 4		
pH Değeri (%10 çözelti)	4,89		

Polipropilen Lif

Çalışmada kullanılan PP lifler gündelik atıklardan geri dönüştürülerek üretilmişlerdir. Atık PP maddelerini yüksek sıcaklıklarda eritildikten sonra ham PP granül haline dönüştürülmüştür. Granül haline getirilen PP'ler tekrar işlemden geçtikten sonra 12 mm uzunluğunda lif haline getirilmiştir. Daha sonra PP liflere potasyum persülfat ve benzoil peroksit ile kimyasal olarak yüzey modifikasyonu işlemi yapılarak yüzey aktifleştirme uygulanmıştır. Yüzey modifikasyon işlemlerinde 3 mL etil kloroformat, 10 gr 12 mm geri dönüştürülmüş PP lif, 0,5 gr Potasyum persülfat, 10 mL saf su kullanılmıştır.

PP liflerin görüntüsü ve özellikleri Şekil 2 ve Tablo 3'de verilmiştir.



Şekil 2. PP liflerin görüntüsü

Tablo 3. PP liflerin Fiziksel Özellikleri

Karışım	Lif uzunluğu (cm)	Lif çapı (µm)	Özgül ağırlık
PP lif	12 mm	18-20	0,91

Yöntem

PP liflerin yüzey aktifleştirme işlemlerinde öncelikle cam reaktör içerisine; 10 g, 12 mm PP lifleri tartılarak ilave edilmiştir (Şekil 3.a). Üzerine 3 mL Etil kloroformat ve 10 mL saf su eklenip 1020 rpm karıştırma hızında ve 60°C sıcaklıkta reaksiyon yapılarak yüzeyi aktifleştirilmiş PP lifleri sentezlenmiştir (Şekil 3.b). Reaksiyon 6 saat süresince 60°C'de 12 saat süresince 20°C'de manyetik karıştırıcı üzerinde karıştırılmıştır (Şekil 3.c). Ardından 80°C ayarlanmış vakumlu etüvde 1 saat boyunca kurutma işlemi gerçekleştirilmiştir.



Şekil 3.a.PP liflerin tartım aşaması, b.PP liflerin ve Etil kloroformatın cam reaktöre eklenme aşaması, c.Sentez Başlangıç aşaması, d.Sentez sonunda PP liflerin görünümleri.

Karışımların Hazırlanması

Harç karışımları, ASTM C109 standardına göre üretilmiştir. Tüm karışımlarda su/bağlayıcı oranı ve yayılma miktarı sırasıyla 0,485 ve 190±20 mm olarak sabit tutulmuştur. Lif içeren karışımlarda toplam hacmin %0,50 oranlarında lif, hacimce agrega ile ikame edilmiştir. Harç karışımlarında istenilen yayılma değerlerini sağlamak için tek tip polikarboksilat-eter esaslı yüksek oranda su azaltıcı katkı farklı dozajlarda kullanılmıştır. Harç karışım hesapları 1 dm³ hacim için yapılmıştır.

Harç Taze Hal Deneyleri

Üretilen harç karışımların yayılma değeri ASTM C1437 standardına göre tespit belirlenmiştir.

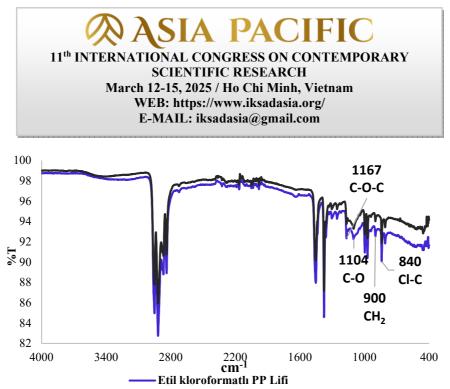
Sertleşmiş Harç Deneyleri

28 günlük 4x4x16 cm boyutlarında harç numunelerinin eğilme ve basınç dayanımları TS EN 196-1 standardına göre belirlenmiştir.

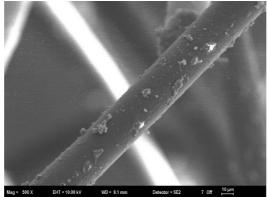
TARTIŞMA VE SONUÇ

Lif karakterizasyonu

Şekil 4 Etil kloroformatın FT-IR spektrumunda yer alan bazı titreşimsel özellikleri, farklı konformerlerin ve bileşiklerin karakteristik titreşimlerini yansıtmaktadır. 1167 cm⁻¹'deki band, ışınlanma sonrası azalan syn-anti formundaki C-O-C antisimetrik titreşimine işaret ederken, 1104 cm⁻¹' deki emilim, ışınlanma süresi arttıkça artan syn-gauche konformeri için C-O germe titreşimini temsil etmektedir. 840 cm⁻¹ ve 807 cm⁻¹'de gözlemlenen özellikler ise sırasıyla syn-anti ve syn-gauche konformerlerinin Cl-C germe modlarını yansıtmaktadır. 900 cm⁻¹'de daha önce OCO deformasyon moduna veya CH₂ sallanma moduna atfedilen band, benzer bileşiklerle yapılan karşılaştırmalar sonucunda, muhtemelen belirli Cl-C germe modlarına karşılık geldiği düşünülmektedir. Ayrıca, düşük frekanslı titreşimler arasında, konformerler arasındaki küçük dalga sayısı farklarını gösteren CO düzlem dışı deformasyon modları da bulunmuştur (Yeny vd., 2008). Etil kloroformat ile klorlanmış PP lifine ait SEM görüntüsünde ise Etil kloroformatın lif yüzeyinde değişikliklere sebep olduğu gözlemlenmiştir (Şekil 5).



Şekil 4. Etil kloroformat ile klorlanmış PP lifi ve işlem görmemiş PP lifine ait FTIR grafiği



Şekil 5. Etil kloroformat ile klorlanmış PP lifine ait SEM görüntüsü

Harç karışımların taze hal özellikleri

Kontrol ve PP lif içeren harç karışımlarında kullanılan su azaltıcı katkı miktarları ile karışımların yayılma değerleri Tablo 4'te sunulmuştur. Tablodan görüldüğü üzere, lif türünden bağımsız olarak karışımlara PP lif eklenmesi, hedeflenen işlenebilirlik değerine ulaşabilmek için gereken katkı miktarını artırmıştır. Etil kloroformat ile yüzey aktifleştirme işlemi yapılan PP lifleri içeren karışımlarda (12-PP-M) ise katkı ihtiyacı işlem uygulanmayan PP lifli karışımlar ile aynı olmuştur.

Tablo 4. Harç karışımlarının yayılma değerleri ve kullanılan su azaltıcı katkı miktarları

Karışımlar	Katkı İhtiyacı (gr)	Katkı Oranı (%)	Yayılma Değeri (cm)
К	0,00	0,00	18,7
12-PP	1,00	0,20	18,2
12-PP-M	1,00	0,20	18,7

*M: Etil kloroformat



Eğilme ve Basınç Dayanımları

Harç karışımlarının 28 günlük eğilme ve basınç dayanım sonuçları Tablo 5'te sunulmuştur. Karışımlara PP lif ilave edilmesi karışımların eğilme dayanımlarını bir miktar artırırken, basınç dayanımlarını çok düşük oranlarda azalma görülmüştür.

Etil kloroformat yüzey aktifleştirme işlemi uygulanan PP lifleri içeren harç karışımların eğilme dayanımı, işlem uygulanmayan PP lifleri içeren karışımların eğilme dayanımından bir miktar fazla olmuştur. Söz konusu yüzey aktifleştirme işleminin PP liflerin matristen sıyrılmasını bir miktar engellediği ve eğilme sırasında meydana gelen çekme çatlaklarını azalttığı böylece eğilme dayanımını iyileştirdiği düşünülmektedir.

PP liflerin basınç dayanımı üzerinde ise belirgin bir etki gözlemlenmemiştir. Karışım sırasında oluşan hafif boşluklar nedeniyle basınç dayanımının bir miktar düştüğü düşünülmektedir. Ancak yüzey aktifleştirme işlemi yapılan PP liflerin bu olumsuz etkiyi biraz azalttığı görülmektedir.

Numune	Eğilme (MPa)	Dayanımı	Basınç (MPa)	Dayanımı
К	7.72		37.60	
12-PP	7.89		35.8	
12-PP-M	8.03		36.6	

Tablo 5. Harç karışımların 28 günlük basınç dayanımı sonuçları

Sonuçlar

• Harç karışımlara polipropilen lif ilave edilmesi hedef yayılma değeri için su azaltıcı katkı ihtiyacını artırmıştır. Etil kloroformat yüzey aktifleştirme işlemi uygulanan PP lifleri içeren karışımlar normal atık PP lifli karışımlar ile katkı ihtiyacı aynı olmuştur.

• Harç karışımlara atık PP lif ilave edilmesi eğilme dayanımını düşük oranda arttırmıştır. PP liflere Etil kloroformat yüzey aktifleştirme işlemi uygulanması eğilme dayanımı normal PP liflere kıyasla düşük oranda geliştirmiştir.

• Atık PP liflerin harç karışımlarda basınç dayanımı üzerinde önemli bir etkisi görülmemiştir. Karışım sırasında numunelerde oluşan düşük oranda boşluklardan dolayı basınç dayanımında az miktar düşüşler gözlemlenmiştir. PP lifler üzerinde yüzey aktifleştirme işlemi uygulanması bu lifi içeren harç karışımının basınç dayanımındaki azalmayı bir miktar düşürmüştür.

TEŞEKKÜR

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POLİPROPİLEN LİFLERİN 1-VİNİL-2-PİROLİDON ile YÜZEY MODİFİKASYONU & ÇİMENTOLU SİSTEMLERDEKİ PERFORMANSI

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ÖZET

Çimentolu sistemler, çevresel etkilere maruz kaldıkça zamanla dayanıklılığını kaybederek cesitli bozulma mekanizmalarına acık hale gelmektedir. Bu olumsuzluklar arasında donmaçözülme döngüleri, aşınma, alkali-silika reaksiyonu (ASR), sülfat saldırısı ve karbonatlaşma gibi olumsuz faktörler yer almaktadır. Bu etkileri minimize etmek amacıyla, mikro ve makro ölçekli çeşitli liflerin kullanımı önerilmektedir. Polipropilen (PP) lifleri, düşük maliyetleri ve çimentolu sistemlerin dayanıklılığını artırma potansiyelleri nedeniyle yaygın olarak tercih edilmektedir. Ancak, polipropilen liflerinin çimento matrisi ile düşük aderans göstermesi, performanslarını sınırlayan temel faktörlerden biridir. Bu çalışmada, polipropilen liflerinin yüzey modifikasyonu gerçekleştirilerek aderans özellikleri iyileştirilmiştir. Bu amaçla, 1-Vinil-2-Pirolidon (1V2P) kullanılarak lif yüzeyi aktif hale ghetirilmiş ve radikal başlatıcı ile yüzey modifikasyonu işlemi sıcak su ceketli cam reaktörde gerçekleştirilmiştir. Yapılan modifikasyon işlemi sonucunda liflerin yüzeyine fonksiyonel kimyasal gruplar eklenmiş ve bu sayede çimento matrisine aderansı önemli ölçüde artırılmıştır. Modifiye edilen polipropilen liflerinin performansındaki bu iyileşmiş, çimentolu sistemlerin mekanik özelliklerinin gelişmesine katkı sağlamıştır. Gerçekleştirilen modifikasyon süreci FTIR ve SEM analizleriyle doğrulanmış olup, elde edilen sonuçlar yüzey modifikasyonunun polipropilen liflerinin çimento sistemleri içindeki etkinliğini artırdığını ortaya koymaktadır. Ayrıca, PP atıklarının geri dönüşümü ile çevresel etkilerin azaltılması ve sürdürülebilir malzeme kullanımı açısından önemli bir katkı sağlanacağı öngörülmektedir.



Bu çalışma, düşük maliyetli ve etkili yüzey modifikasyon yöntemlerinin geliştirilmesine öncülük ederek, çimentolu sistemlerin dayanıklılığını artırmaya yönelik yeni yaklaşımlar sunmaktadır.

Anahtar Kelimeler: Çimentolu sistemler, polipropilen lif, yüzey modifikasyonu, 1-Vinil-2-Pirolidon, lif geri dönüşüm.

SURFACE MODIFICATION OF POLYPROPYLENE FIBRES WITH 1-VINYL-2-PYRROLIDONE & PERFORMANCE IN CEMENTITIOUS SYSTEMS

ABTRACT

Cementitious systems lose their durability over time as they are exposed to environmental influences and become vulnerable to various degradation mechanisms. These include freezethaw cycles, abrasion, alkali-silica reaction (ASR), sulfate attack and carbonation. In order to minimize these effects, the use of various micro and macro-scale fibers is recommended. Polypropylene (PP) fibers are widely preferred due to their low cost and potential to increase the durability of cementitious systems. However, the low adherence of polypropylene fibers with the cement matrix is one of the main factors limiting their performance. In this study, the adhesion properties of polypropylene fibers were improved by surface modification. For this purpose, the fiber surface was activated using 1-Vinyl-2-Pyrrolidone (1V2P) and surface modification with radical initiator was carried out in a hot water jacketed glass reactor. As a result of the modification process, functional chemical groups were added to the surface of the fibers and thus the adherence to the cement matrix was significantly increased. This improved performance of the modified polypropylene fibers contributed to the improvement of the mechanical properties of the cementitious systems. The modification process was confirmed by FTIR and SEM analyses and the results show that surface modification improves the efficiency of polypropylene fibers in cementitious systems. Furthermore, it is envisaged that recycling of PP waste will make a significant contribution in terms of reducing environmental impacts and sustainable material utilization. This study provides new approaches to improve the durability of cementitious systems by pioneering the development of low-cost and effective surface modification methods.

Keywords: Cementitious systems, polypropylene fiber, surface modification, 1-Vinyl-2-Pyrrolidone, fiber recycling.

GİRİŞ

Çimento, geniş uygulama alanları nedeniyle en yaygın kullanılan inşaat malzemelerinden biridir. Betonun başlıca dezavantajları arasında görece düşük çekme mukavemeti ve çatlak açılması ile yayılmasına karşı zayıf direnci yer almaktadır (Rashiddadash, vd., 2014; Brandt, 2008; Afroughsabet & Ozbakkaloglu, 2015). Çimentonun özelliklerini iyileştirmek ve farklı koşullarda ekonomik bir şekilde kullanılabilirliğini artırmak amacıyla bir dizi araştırma gerçekleştirilmiştir. Son dönemde çimentolu sistemlerin performansını artırmak, malzeme özelliklerini iyileştirmek ve sürdürülebilirlik sağlamak amacıyla son yıllarda lif takviyesi yaygın bir şekilde kullanılmaktadır (Elkatatny vd., 2020). Eski çağlarda mühendisler ve mimarlar, yapıları yıkıcı etkilerden korumak için saman, hayvan kılı ve çeşitli doğal lifler kullanımışlardır (Erbas, 2003; Latifi vd., 2022).



Ayrıca, sentetik liflerin geliştirilmesi, sanayiye önemli katkılar sağlamış ve bugün özellikle polipropilen (Pakravan, vd., 2012; Latifi vd., 2022), poliolefin ve polivinil alkol gibi yeni sentetik lif türleri, farklı projelerde kullanılmaktadır (Latifi vd., 2022).

Düşük maliyet, hafiflik ve üstün korozyon direnci gibi özellikleri göz önünde bulundurulduğunda, otomotiv, tüketici ürünleri ve ev eşyaları gibi geniş bir kullanım alanına sahip polimerler, son 25 yıldır beton karışımlarında kullanılmaktadır (Fowler, 1999; Parenteau vd., 2012; Doğan & Demir, 2021). Polipropilen lifi, Polietilen lifi, Polietilen tereftalat lifi, Poliamid lifi, Polivinil alkol lifi ve Poliakrilonitril lifi, çimento esaslı kompozitlerde yaygın olarak kullanılan liflerdir (Oh vd., 2005; Ochi vd., 2007; Doğan & Demir, 2021).

PP lifleri, dünya çapında yıllık 4 milyon ton üretimi yapılan yeni nesil lifler olarak tanımlanmaktadır (Madhavi vd. 2014). PP liflerinin yoğunluğu 0.91 g/cm³, çekme dayanımı 500 - 700 MPa, elastik modülü 2800 MPa ve kopma noktasındaki uzama oranı %25'tir (Olgun, 2013). PP lifleri, çelik liflere kıyasla daha düşük dayanım ve elastik modüle sahiptir. Diğer taraftan, PP lifleri, dökümlü özellikleri, ince yapıları ve dağılma özellikleri sayesinde plastik çatlakları önlemeye yardımcı olur (Bayasi ve McIntyre, 2002; Doğan ve Demir, 2021). Düşük elastik modüle sahip PP lifleri, betonun rijitlik modülü ile PP liflerinin modülünün, sertleşmenin ilk saatlerinde birbirine yakın olması nedeniyle, betonun büzülmesini kontrol etmek amacıyla küçük oranlarda kullanılır (Banthia ve Gupta, 2006). PP liflerinin betondaki dayanımı artırması beklenmemekle birlikte, bu liflerin kullanımı ile betonu daha esnek, dayanıklı ve darbeye karşı dirençli hale getirmek amaçlanmaktadır (Alhozaimy vd., 1996; Toutanji vd., 1998; Pakravan ve Özbakkaloğlu, 2019 ; Doğan ve Demir, 2021).

Li ve ekibinin (2024) çalışmasında, çimento bazlı kompozitlerin mekanik dayanım ve dayanıklılığını artırmak amacıyla bazalt ve polipropilen lifleri tekli ve karışık (1:1) katkı yöntemleriyle kullanılmıştır. Araştırmada, basınç dayanımı, kuruma çekme ve donmaçözülme döngüsü testleri ile farklı fiber içeriklerinin etkileri incelenmiş ve mikroyapı özellikleri taramalı elektron mikroskobu (SEM) ve cıva intrüzyon testiyle analiz edilmiştir. Sonuçlar, her iki lifin tekli katkılarının basınç dayanımın önemli ölçüde artırmadığını, ancak fleksiyon dayanımını belirli dozaj aralıklarında etkili bir şekilde güçlendirdiğini göstermiştir. 1:1 karışım oranının üstün bir güçlendirme ve dayanıklılık etkisi gösterdiği, kuruma çekme ve kütle kaybı oranlarını azalttığı ve kompozitlerin donma-çözülme döngüsüne karşı dirençlerini artırdığı belirlenmiştir. Fiberlerin çimento matrisine sıkı bir şekilde bağlanarak, rastgele dağıldığı ve bir ağ yapısı oluşturarak malzemedeki kırılma noktalarını engellediği, zararlı gözenekleri dönüştürerek yapıyı rafine ettiği ve kompozitin yoğunluğunu artırdığı gözlemlenmiştir.

Anas Ahmed ve ekibinin (2024) çalışmasında, yüksek basınç ve yüksek sıcaklık koşullarında petrol kuyusu çimentolarının performansını iyileştirmek amacıyla polipropilen (PP) liflerinin kullanımı incelenmiştir. Çalışmada, polipropilen liflerinin çimento karışımına eklenmesiyle, çimentoların mekanik özelliklerinin ve dayanıklılık özelliklerinin artırılması hedeflenmiştir. Test sonuçları, lif eklemenin çimentonun mekanik özelliklerini iyileştirdiğini, kalınlaşma süresini hızlandırdığını, poroziteyi ve geçirgenliği azalttığını ve yüksek basınç ve yüksek sıcaklık koşullarında dayanabilecek yeni bir çimento şlamı tasarımına yardımcı olduğunu göstermiştir. Mikroyapısal analizler, polipropilen fiber parçacıklarının çimentodaki gözenekleri doldurup kapiller boşlukları tıkayarak yoğun bir çimento yapısı sağladığını ortaya koymuştur.



Jia ve ekibinin (2020) çalışmasında, betonun su geçirimsizliğini, darbe direncini, aşınma karsıtlığını ve catlama direncini artırmak amacıyla polipropilen (PP) liflerinin kullanımı ele alınmıştır. Bu araştırmada, PP lifleri ile çimento arasındaki ara yüzey bağlanabilirliğini artırmak için mikro-silika (MSi) kullanılarak bir dizi PP kompozit lifi hazırlanmış ve bu kompozit liflerin yapısı ve özellikleri incelenmiştir. Sonuçlar, kompozit liflerin, saf PP liflerine göre daha pürüzlü ve daha hidrofilik yüzeyler sergilediğini göstermiştir. Tek lif çekme testleriyle, PP lifleri ile çimento matrisi arasındaki ara yüzey bağlanabilirliğinin, MSi eklenmesiyle arttığı gözlemlenmiştir. Kompozit liflerle katkı yapılan çimento harcının, saf PP lifleriyle modifiye edilen çimentoya kıyasla çok daha iyi fleksiyon dayanımı ve basınç dayanımına sahip olduğu bulunmuştur. Özellikle %10 ağırlıkça MSi içeren kompozit liflerle güçlendirilmiş çimento harcı, en iyi mekanik dayanımı göstermiştir; bu durumun, lif dayanımı ile ara yüzey bağlanabilirlik gücü arasındaki dengeye dayandığı öne sürülmüstür. Genel olarak, araştırma, uygun miktarlarda MSi karıştırılmış PP liflerinin, PP lifleriyle güçlendirilmiş çimento bazlı malzemelerin mekanik özelliklerini daha da iyileştirebileceğini ve bu yaklaşımın modern mimari için yüksek performanslı malzemelerin tasarımında yeni bir strateji sunduğunu ortaya koymuştur.

Bu çalışmada, kullanılan polipropilen (PP) lifleri, günlük atıklardan geri dönüştürülerek üretilmiştir. Atık PP malzemeleri, yüksek sıcaklıkta eritildikten sonra, ham PP granüllerine dönüştürülmüştür. Ardından, granül halindeki PP malzemeleri tekrar işlenerek 12 mm uzunluğunda liflere dönüştürülmüştür. PP liflerinin yüzey özelliklerinin iyileştirilmesi amacıyla, liflerin yüzeyleri kimyasal bir işlemle, 1-Vinil-2-Pirolidon ile modifiye edilmiştir. Bu işlem, liflerin yüzey enerjisini artırarak, çimento matrisi ile daha iyi bir aderans sağlamayı hedeflemiştir. Deney çalışmalar kapsamında yüzey modifikasyonu gerçekleştirilmiş PP liflerin çimentolu sistemlerin basınç ve eğilme dayanımlarına etkileri araştırılmıştır.

MATERYAL ve YÖNTEM

Malzeme

Çimento

Bu proje kapsamında harçta kullanılmak üzere TS EN197-1 standartlarına uygun, CEM I 42.5 R tipi çimento kullanılmıştır. Çimentoya ait fiziksel, kimyasal ve mekanik özellikler Tablo 1'de verilmiştir.

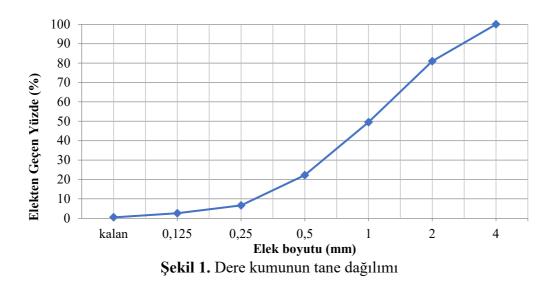
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Oksit (%)	Çimento	Fiziksel Özell	likler	
SiO ₂	18.86	Özgül Ağırlık		3.15
Al_2O_3	5.71	İncelik		
Fe ₂ O ₃	3.09	Özgül yüzey (Blaine, cm ² /g)	3530
CaO	62.70	0.045 mm elel	kte kalıntı (%)	7.6
MgO	1.16	Mekanik Öze	ellikleri	
SO ₃	2.39		1-günlük	14.7
Na ₂ O+0,658 K ₂ O	0.92	Basınç	2-günlük	26.80
Cl'	0.01	Dayanımı (MPa)	7-günlük	49.80
Çözünmeyen kalıntı	0.32	(1 111 u)	28 günlük	58.5
Kızdırma kaybı	3.20			
Serbest CaO	1.26			

Tablo 1. Çimentonun fiziksel, kimyasal ve mekanik özellikleri

Agrega

Harç karışımlarının üretiminde 0-4 mm tane çapına sahip dere kumu agregası kullanılmıştır. Kullanılan agreganın gradasyon eğrisi Şekil 1'de gösterilmiştir. Agreganın TS EN 1097-6 standardına göre suya doygun yüzey kuru özgül ağırlığı 2,64 ve su emme kapasitesi %0,4 olarak ölçülmüştür.



Su Azaltıcı Katkı

Harç karışımlarda hedeflenen yayılma ve çökme değerlerini sağlamak için tek tip polikarboksilat esaslı yüksek oranda su azaltıcı katkı kullanılmıştır. Kullanılan su azaltıcı katkının üretici firma tarafından temin edilen bazı özellikleri Tablo 2'de verilmiştir.



Tablo 2. Su azaltıcı katkı kimyasal özellikleri			
Özellikler	Değerler		
Yoğunluğu (gr/cm ³)	1,073		
Kimyasal bileşiği	Polikarboksilat esaslı sıvı		
Katı madde oranı (%)	28,76		
Klor içeriği (% kütlece)	0,0618		
Alkali miktarı (% kütlece)	_≤4		
pH Değeri (%10 çözelti)	4,89		

Polipropilen Lif

Çalışmada kullanılan PP lifler gündelik atıklardan geri dönüştürülerek üretilmişlerdir. Atık PP maddelerini yüksek sıcaklıklarda erittikten sonra ham PP granülü haline getirilmektedir. Granül haline getirilen PP'ler tekrar işlemden geçtikten sonra 12 mm uzunluğunda lif haline getirilmektedir. PP liflerin görüntüsü ve özellikleri Şekil 2 ve Tablo 3'te verilmiştir. PP liflere potasyum persülfat ve Benzoil Peroksit ile kimyasal olarak yüzey modifikasyonu işlemi yapılarak yüzey aktifleştirme uygulanmıştır. Yüzey modifikasyonu işleminde 10 gr 12 mm PP Lif, 10 mL saf su, 2 gr 3-Chloro-2-Chloromethyl-1-Propene, 5 mL 1-Vinil-2-Pirolidon, 2 gr Potasyum Persülfat ve 10 mL Etanol kullanılmıştır.



Şekil 2. PP liflerin görüntüsü

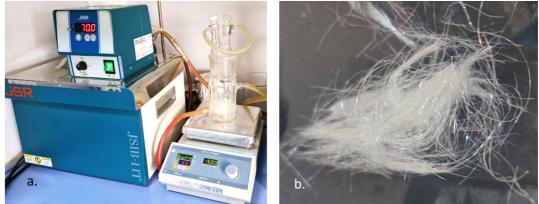
Karışım	Lif uzunluğu (cm)	Lif çapı (µm)	Özgül ağırlık
PP lif	12 mm	18-20	0,91

Yöntem

Lif modifikasyon işlemi

Sıcak su ceketli reaktör içerisine; 10 g, 12 mm PP + 10 mL saf su + 2 g 3-Chloro-2-Chloromethyl-1-Propene alınarak 60°C de 5 saat boyunca ve 25°C de 24 saat boyunca karıştırılmıştır ve 70°C 60 dk süresince vakumlu etüvde kurutulmuştur. Ardından ayrı bir beher içerisinde 10mL etanolde 5 mL, 1-Vinil-2-Pirolidon çözündürülerek 70°C'ye ayarlı reaktör içerisine alınmıştır. Reaktör içerisine bir kurutulan pp liflerden 5g tartılarak eklenmiştir. 2g potasyum persülfat eklenmesinin ardından reaksiyon başlatılmıştır (Şekil 3). 5 saat boyunca karıştırılmanın ardından yeniden 70°C 60 dk süresince vakumlu etüvde kurutma işlemi gerçekleştirilmiştir.





Şekil 3. a. Reaksiyon başlangıç aşaması, b. Modifiye edilmiş liflerin görünümü

Karışımların Hazırlanması

Harç karışımları, ASTM C109 standardına göre üretilmiştir. Tüm karışımlarda su/bağlayıcı oranı ve yayılma miktarı sırasıyla 0,485 ve 190±20 mm olarak sabit tutulmuştur. Lif içeren karışımlarda toplam hacmin %0,50 oranlarında lif, hacimce agrega ile ikame edilmiştir. Harç karışımlarında istenilen yayılma değerlerini sağlamak için tek tip polikarboksilat-eter esaslı yüksek oranda su azaltıcı katkı farklı dozajlarda kullanılmıştır. Harç karışım hesapları 1 dm³ hacim için yapılmıştır.

Karıştırma işlemi, ASTM C305 standardına göre çimento mikseri yardımıyla gerçekleştirilmiştir. İlk olarak, su üzerine çimento ilave edildikten sonra 30 saniye boyunca 140 devir/dakika (yavaş) hızla karıştırma işlemi uygulanmıştır. Ardından oluşan çimento hamuruna kum ve lif ilave edilerek, 30 saniye boyunca 140 devir/dakika hızında karıştırma işlemi yapılmış, ardından 30 saniye süreyle 285 dev./dk. hızında karıştırılmıştır. Mikser durdurulmuş ve karışım 90 saniye bekletilmiştir. Bu süreçte, mikser kabının kenarları ilk 15 saniye içinde sıyrılmıştır. Su azaltıcı kimyasal katkı eklenmesinin ardından harç karışımı, 285 dev./dk. hızında 60 saniye daha karıştırılmıştır.

Harç Taze Hal Deneyleri

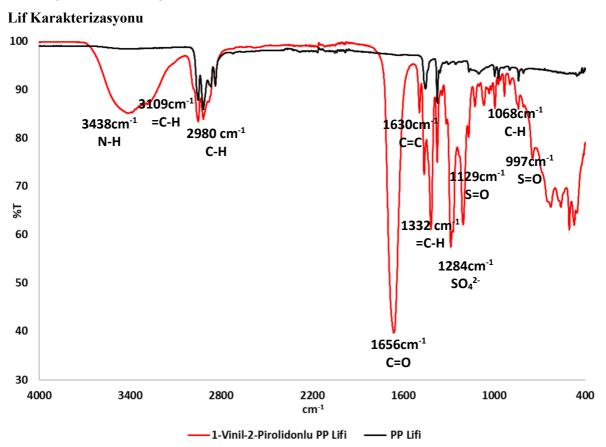
Üretilen harç karışımların yayılma değeri ASTM C1437 standardına göre tespit belirlenmiştir.

Sertleşmiş Harç Deneyleri

28 günlük 4x4x16 cm boyutlarında harç numunelerinin eğilme ve basınç dayanımları TS EN 196-1 standardına göre belirlenmiştir.



TARTIŞMA VE SONUÇ

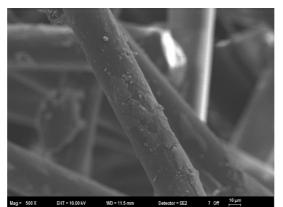


Şekil 4. 1-Vinil-2-Pirolidon ile modifiye edilmiş PP lifi ve işlem görmemiş PP lifine ait FTIR grafiği

1-vinil-2-pirolidon monomerinin FTIR spektrumu Şekil 4'te gösterilmektedir. Bu monomerin moleküler yapısında beş üyeli bir laktam halkası bulunur ve yoğun fazda cis-cis dimer formunda yer aldığı bilinmektedir (Jimenez vd., 2019). Laktam karbonil grupları tipik olarak vaklasık 1705 cm⁻¹ civarında soğurma gösterirken, 1-vinil-2-pirolidon monomerinin FTIR spektrumunda bu karakteristik bant 1706 cm⁻¹'de gözlemlenmektedir. Vinil grubunun asimetrik valans titreşimleri, vas (=C-H), 3109 cm⁻¹'de belirgin bir absorpsiyon bandı oluşturmaktadır. Vinil grubuna ait düzlem içi deformasyon titreşimleri, δ (=C-H), 1332 cm⁻¹'de, düzlem dışı deformasyon titreşimleri, γ (=C-H), ise 981 cm⁻¹'de maksimum absorpsiyon göstermektedir. CH₂ grubunun asimetrik C-H valans titreşimleri, vas (C-H), 2980 cm⁻¹ ve 2875 cm⁻¹'de absorpsiyon bantları oluşturmaktadır. Ayrıca, VP molekülündeki CH₂ grubuna ait C-H deformasyon titreșimleri, δ (C-H), 1461 cm⁻¹'de orta șiddette bir absorpsiyon bandı oluşturmaktadır. Molekül yapısında bulunan C=C çift bağının valans titreşimleri, v (C=C), 1630 cm⁻¹'de düşük şiddette bir absorpsiyon bandı ile kendini göstermektedir (Ilić-Stojanović ve Eraković, 2019). 3438cm⁻¹ – 3289cm⁻¹ de görülen broad piklerin 1-Vinil-2-Pirolidon N-H stretching bağına, 1656cm^{-1'de} görülen C=O stretching bağına ait olabileceği düsünülmektedir. Aynı zamanda 997cm⁻¹ ve 935cm⁻¹ aralığında gözlenen güclü C=C bending bağına ait olabileceği tahmin edilmiştir.



Parmak izi bölgesinde görülen; 1068 cm⁻¹ ve 455 cm⁻¹ aralığında gözlenen piklerin 3-Chloro-2-Chloromethyl-1-Propene molekülünde bulunan C-H bağlarına ait olduğu düşünülmektedir. Parmak izi bölgesindeki; 1129cm⁻¹ S=O bağlarına, 997 cm⁻¹ pikleri S-O, 1284 cm⁻¹ SO4²⁻ bağlarına dolayısıyla Potasyum persüfat'a ait pikler olabileceği düşünülmektedir. 1-Vinil-2-Pirolidon ile modifiye edilmiş PP lifine ait SEM görüntüsü Şekil 5'te verilmiştir.



Şekil 5. 1-Vinil-2-Pirolidon ile modifiye edilmiş PP lifine ait SEM görüntüsü

Taze hal özellikleri

PP lif içeren harç karışımlarında kullanılan su azaltıcı katkı miktarları ve karışımların yayılma değerleri Tablo 4'te gösterilmiştir. Tablodan görüldüğü gibi lif tipinden bağımsız olarak karışımlara PP lif eklenmesi hedef işlenebilirlik değeri için katkı gereksinimini arttırmıştır. PP life 1-Vinil-2-Pirolidon yüzey aktifleştirme işlemi yapılması 12 mm uzunluğundaki lif içeren karışımlarda katkı ihtiyacını değiştirmemiştir.

Karışımlar	Katkı (gr)	İhtiyacı Katkı (%)	Oranı Yayılı (cm)	na Değeri
Κ	0,00	0,00	18,7	
12-PP	1,00	0,20	18,6	
12-PP-M	1,00	0,20	18,4	

Tablo 4. Harç karışımlarının yayılma değerleri ve kullanılan su azaltıcı katkı miktarları

*M: 1-Vinil-2-Pirolidon

Eğilme ve Basınç Dayanımları

Harç karışımların 28 günlük eğilme ve basınç dayanım sonuçları Tablo 5'te gösterilmiştir. 12 mm uzunluğuna sahip liflere 1-Vinil-2-Pirolidon yüzey aktifleştirme işlemi uygulaması ile harç karışımlarının eğilme dayanımı artırmıştır (Tablo 5). Bu durum, eğilme sonucu oluşan çekme çatlaklarını azaltarak eğilme dayanımlarının artmasını sağlamış olabilir.

PP liflerin basınç dayanımı üzerinde önemli bir etkisi görülmemiştir. Dayanımlarda karışım esnasında oluşan bir miktar boşluğa bağlı olarak basınç dayanımlarının az miktarda düştüğü düşünülmektedir.



Numune	Eğilme (MPa)	Dayanımı	Basınç (MPa)	Dayanımı
Κ	7.72		37.60	
12-PP	8.10		36.30	
12-PP-m	8.22		37.20	

Tablo 5. Harc	karısımların 28	günlük hasını	c dayanımı sonuçları
\mathbf{I} abit \mathbf{J} . Half	$\kappa a i s i i a i a i a 20$	gumuk basini	y uayammi somuçian

Sonuçlar

• Harç karışımlara polipropilen lif ilave edilmesi hedef yayılma değeri için su azaltıcı katkı ihtiyacını artırmıştır.

• PP lifler üzerinde yapılan 1-Vinil-2-Pirolidon yüzey aktifleştirme işlemi harç karışımların yayılma değeri üzerinde önemli bir değişim göstermemiştir.

• Harç karışımlara 12 mm lifler eğilme dayanımını arttırmıştır.

• PP liflere uygulanan yüzey aktifleştirme işleminin basınç dayanımı üzerinde önemli bir etkisi görülmemiştir.

TEŞEKKÜR

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THE SPATIAL TRANSFORMATION PROCESS OF NEVŞEHİR CASTLE AND ITS NEIGHBOURHOODS

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Abstract

Nevsehir Castle and its neighbourhoods, with their historical and cultural values, are considered important heritage sites in the region. The multi-layered structure of Nevsehir has a rich urban texture that hosts historical traces of different periods together. However, the spatial transformation processes carried out in recent years require a critical examination of the preservation of this multi-layered structure, particularly in terms of the sustainability of urban identity and its usage. In this study, the process of spatial transformation in and around Nevsehir Castle is analysed. Through on-site observations of the current situation, the focus has been placed on the present condition of the castle and its surroundings; the spatial impacts of the transformation have been addressed and discussed. In addition, the castle and its surroundings are evaluated within the framework of environmental and historical conservation approaches, and the effects of the changes on the continuity of the multi-layered historical texture are analysed. As a result, in the light of the evaluations made, suggestions have been developed to improve the current situation of the area and to increase its contribution to the urban identity. In this context, it has been emphasized that strategic planning is required to preserve the historical and cultural potential of Nevşehir Castle and its surroundings while enhancing the area's social, cultural, and touristic values.

Keywords: Spatial change, urban transformation, Nevşehir, cultural heritage, urban identity, multi-layered city

INTRODUCTION

Many cities in Turkey have a multi-layered structure. This layered structure is not only physical but also includes an order in which archaeological and cultural elements are intertwined with each other through horizontal and vertical relations (Belge, 2023). These multilayered cities have continuously served as settlements since their establishment and have maintained this function to the present day. The relationship that each period establishes with the previous period and the physical structure formed in connection with this relationship contribute to the depth and richness of today's city (Bilgin Altınöz, 2022). Understanding these relationships is the most basic requirement for preserving the multi-layeredness of the city (Binan, 2013).

A city's historical and cultural heritage, natural and built environment features, architectural features, social, economic and cultural structure play an important role in the formation of urban identity (Ersoy and Aghayeva, 2024).



The preservation of these elements, which form the identity of multi-layered cities, is crucial for establishing historical continuity and ensuring the sustainability of urban identity (Karabağ, 2019). Multilayered cities should be managed through a spatial analysis and planning process that aligns with the unique conditions of the site (Belge, 2023). However, due to deficiencies in spatial data, analytical methods, and the development of conservation strategies, existing tools and methods often prove inadequate for preserving historical layers. Consequently, this leads to the loss of multilayered urban characteristics (Binan, 2013).

In Turkey, multilayered cities such as Ankara, Antakya, Amasya, and İzmir have been the subject of various research studies (Belge, 2023). As one of these multilayered cities, Nevşehir stands out with its underground and aboveground layers, as well as the spatial fabric shaped by these layers. Nevşehir Castle and its surroundings serve as the focal point of this multilayered structure and, with their historical and cultural significance, constitute an important heritage site in the region. However, the spatial transformation processes carried out over the past 15 years necessitate a critical examination in terms of the identity, usage, and sustainability of this historical area.

This study investigates the spatial development of Nevşehir alongside the transformation process of Nevşehir Castle and its surroundings. By analyzing the current state of the area, the study focuses on the present condition of the castle and its surroundings while discussing the impacts of transformation. Additionally, the area is examined through the lens of environmental and historical conservation approaches, assessing the effects of these transformations on the continuity of historical fabric and identity.

THE SPATIAL TRANSFORMATION PROCESS OF NEVŞEHİR CITY

The Cappadocia region, which dates back to 5000 BC, was first called 'Nissa' during the Hittite period. Then Phrygians, Lydians, Assyrians dominated the region and this region was named 'Katpatuka' during the Assyrian period. In the following period, Persians captured the region. In the Middle Ages and the New Age, this region was referred to as 'Seandos' by the Byzantines. It is said that Seljuks and Ottomans also lived in this region in the following period (Özberk, 2017). Although there is a lot of data on the large geographical area covered by the borders of Nevşehir province in Antiquity and the Middle Ages, there is limited data on the present city centre (Erpek et al., 2021). In line with the recent investigations in Nevşehir castle and rock-carved slope settlement, it is understood that the construction dates back to the 6th century. The rock-carved church in the region is dated to the 13th century (Uyar, 2017). Thus, it is suggested that the rock-carved slope settlement, which is part of the present castle, belonged to a developed medieval village (Erpek et al., 2021).

The oldest known written sources of the city belong to the 16th century. In the records of 1518, the city is a village named 'Muşkara' in the Ürgüp kaza of Niğde Sanjak. This village is a place where approximately 450 people live, consisting of 86 households. In the records of 1584, it is said that the population in this village increased and reached approximately 1000 people (Erpek et al., 2021). During the Ottoman Period, Damat İbrahim Pasha changed the name of this village to Nevşehir with the reconstruction activities he carried out (Bayrakal, 2011). The oldest map of the city, the map of 1730, which coincides with the period of Damat Ibrahim Pasha's activities, shows the situation of the city at that time (Figure 1). According to Becerir, this map, on which monumental buildings are marked, shows that Nevşehir evolved from a town to a city (Becerir, 2020).



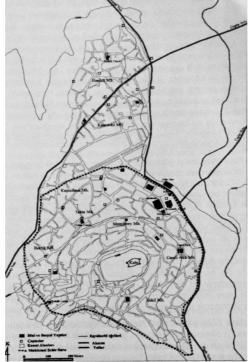


Figure 1. A map of 1730 showing the castle and its surroundings (Toroğlu, 2011)

One of the most important reconstruction activities of Damat Ibrahim Pasha in the city is the külliye complex he built on the periphery of the castle in 1726. This complex extended the development of the city towards the northeast of the castle. The Damat Ibrahim Pasha Complex is a symbolic building complex in the southwest of the city with a mosque, madrasah, sanbyan school, imaret, caravanserai, hammam and two fountains. One of the last examples of classical Ottoman architecture, the complex served as the city's trade and education centre for a long time (Anadol, 1970; Baykara, 1996). In addition to the complex, other important historical buildings in the city are the Ottoman-era Kurşunlu Mosque, Orta Bekdik Mosque, Aşağı Bekdik Mosque, Tahta Mosque, Kara Mosque, Eskili Mosque, Hacı Şeyh Efendi Mosque, Hacı Nasuh Mosque, Virgin Mary Church and the Bell Tower, which is the remains of a destroyed church (Eyice, 1980). In Şemsettin Sami's Kâmûsu'l-A'lâm, written in 1898, information about both the population of the city at that time and the list of historical buildings were presented. Accordingly, a total of 1117 buildings, including 18 mosques, 1 masjid, 6 madrasahs, 2 baths, 14 inns and 1076 shops, were recorded in the city (Bayrakal, 2011). In the same book, the population of the city is stated as 17.000 people.

In the Konya Vilayet Salname dated 1881-1882, the population data of different religious groups in Nevşehir and its surrounding towns were included. As a result of the census based only on the male population, a total population of 14.819 was determined, including 11.121 Muslims, 3526 Greeks, 184 Armenians, 8 Protestants and 52 Catholics (Kaya, 2006). This situation shows that communities belonging to different religious groups lived together in the city.

The construction date of Nevşehir Castle, which was built on the top of the underground city, is not known for certain (Erpek, 2024), but it is said to date from the Seljuk period (Sözen, 2000).



The only definite information about the existence of the castle before the eighteenth century is found in the records regarding the construction activities carried out by Damat İbrahim Pasha (1718-1730). These records indicate that Damat İbrahim Pasha had a pre-existing castle rebuilt on the site of the present castle (Erpek et al., 2021). The importance of Nevşehir Castle as a stop for the protection of the Old Roman Road and the Baghdad Silk Road is also emphasised (Kayaşehir Catalog, 2021)

It is suggested that the historical center of Nevşehir spread across the eastern slope of the castle in the early 20th century. Photographs from 1912 reflecting the city's appearance at the time indicate that Nevşehir was a prosperous and developed settlement during this period (Özbay, 2024). A 1912 photograph of Nevşehir captured by Garabed Kirkor Solakian is presented in Figure 2. This photograph shows the city extending from the foothills of Kahveci Dağı (on the left) to the Castle and its surroundings (on the right). The area referred to as Kahveci Dağı and its surroundings were predominantly inhabited by the Greek (Rum) community. This region housed a Greek neighborhood divided into three sections: Rum Baş (Upper Greek), Rum Orta (Middle Greek), and Rum Aşağı (Lower Greek). In this settlement, which was adapted to the topography, there were not only grand residences but also fountains, a marketplace, shops, various schools, a library, two churches, and a bathhouse (URL-1).



Figure 2. Kahveci Mountain foothills, Nevsehir Castle and settlement around it, 1912 (URL-1)

The 1924 population exchange marked a turning point for this area, as the departure of the Greek population led to the gradual abandonment of the neighborhood (URL-1). Additionally, the proclamation of the Republic initiated new urban development activities, causing the city center to shift from the castle's foothills toward the north.

In the 1920s, the proclamation of the Republic and the subsequent modernization process led to significant physical and social transformations in the city center. New educational and healthcare institutions, banks, and various governmental offices began to develop along Atatürk Boulevard, located north of the castle (Çakırbaş and Özdemir, 2015). As a result, both the departure of the non-Muslim population and the modernization process rendered the castle and its surroundings increasingly neglected.

From this period onward, abandoned structures began to accommodate incoming migrant populations. Simultaneously, structural interventions, additions, and deterioration intensified.

Traditional stone masonry craftsmanship and construction techniques were gradually replaced by reinforced concrete structures and modifications (Becerir, 2020).



In 1954, Nevşehir gained the status of a province. From this period until the 1970s, the city's traditional urban fabric remained largely unchanged. This stability can be attributed to the fact that Nevşehir did not transform into a major industrial or commercial center and instead maintained an economy based primarily on agriculture and livestock (Bayrakal, 2011). Accordingly, the city's population did not experience a significant increase during this period. While the population was 31.162 in the 1940s, it rose to 48.028 by 1965. However, a noticeable population growth occurred after the 1990s, reaching approximately 90.000 (URL-2).

During the 1980s, the accelerated urbanization and apartment construction process across Turkey also impacted Nevşehir, leading to spatial and social transformations in and around the castle. The original residents began to leave the city center, gradually being replaced by lower-income groups (Özberk, 2017). The appearance of Nevşehir Castle and its surroundings before the urban transformation decision is shown in Figure 3.



Figure 3. Nevşehir Castle and its surroundings before urban transformation (URL-3)

Consequently, until the 2000s, the castle and its surroundings became a densely built-up area. A map illustrating the settlement pattern and registered structures in the 2000s is presented in Figure 4.

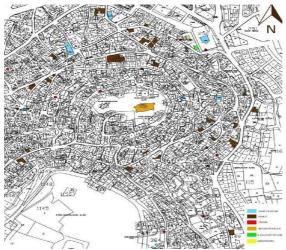


Figure 4. The Current Situation of the City in 2000 and Registered Structures (Halaç and Eranıl, 2018)

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In 2009, a Decree Law was enacted, removing the Nevşehir city center from the designated tourism zone. This decision led to a major spatial transformation in the area, now under the jurisdiction of the municipality (Özbay, 2024). The exclusion of the historic city center from the tourism zone paved the way for urban development activities. In 2012, in collaboration with TOKI (Housing Development Administration of Turkey), a villa project was proposed for the area, aiming for urban transformation by demolishing the existing historical fabric (Figure 5).



Figure 5. Urban transformation project proposed in the area in 2012 (Özbay, 2024)

In the project financed through the collaboration of TOKİ and the municipality, the local residents of the area were relocated to mass housing units constructed by TOKİ in a different part of the city. The urban transformation process was carried out through a mechanism based on the distribution of generated value rather than expropriation. To mitigate potential conflicts and disruptions in the process, an agreement was reached with landowners (Özberk, 2017). In this regard, the process began with clearing works, and by the end of the process, a standardized project proposal was developed without considering the traces and cultural characteristics that constituted the initial settlement fabric of the city's historical layers. The planned construction in the area is given in Figure 4. In 2014, when the demolition works of the municipality were completed, only masjids remained from 11 neighbourhoods (785 acres) in the area. In addition to the neighbourhoods, the historical stream bed called 'Öz' and vineyard-garden areas were also destroyed. Trees in the area were cut down and the stream bed was filled with excavations. In 2014, a mosque complex was constructed on a landfilled stream bed (Özbay, 2024).

Özberk (2017) describes the rationale behind this urban transformation in Nevşehir as follows: "The government decided to demolish the old city center based on a high-modernist ideology, aiming to make the city and its population more governable, maximize land value (rent), and enhance the overall urban image. The objective was to simplify and make the city more legible by clearing what was perceived as a deteriorated urban area, supposedly improving human conditions, local livelihoods, and the city's image. However, due to the narrow-minded policies of the state and the dismissal of local communities and their collective knowledge, the project failed, ultimately resulting in urban destruction."

As seen in many ill-conceived urban transformation projects, the urban renewal process in Nevşehir caused significant social, economic, and spatial losses for the city. According to Gregory (2009), urban transformation projects are expected to reshape spaces and address economic, social, and spatial issues in declining areas.



However, as in many other cases, the social, cultural, and economic concerns of local communities in Nevşehir were largely overlooked, leaving public demands and expectations unaddressed (Güzey, 2012).

In general, urban transformation projects tend to displace local communities, leading them to gradually abandon the area. A similar process took place in Nevşehir, where the project erased local identity, cultural heritage, urban memory, coexistence of diverse communities, cosmopolitan structure, and neighborhood life. This resulted in an exclusive and incompatible form of urban segregation (Özberk, 2017).

In 2014, while the urban renewal process and the associated site clearance were still underway, an underground city was discovered in the vicinity of Nevşehir Fortress. This discovery significantly altered the course of the ongoing transformation process (Arslan and Şıkoğlu, 2017). The rock-cut hillside settlement revealed a variety of structures dating back to the 6th century, including a monastery, a Byzantine rock church from the first quarter of the 13th century, multi-level tombs, public spaces, religious ritual and gathering areas, residential spaces, workshops, passageways, water tunnels, linseed oil mills, and stables (Kayaşehir Catalog, 2021).

According to Decision No. 1266, issued on October 17, 2014, by the Nevşehir Regional Board for the Protection of Cultural Heritage, the Nevşehir Fortress and its surroundings were designated as a third-degree archaeological site (Figure 6). As a result of this decision, the urban transformation project was canceled. Since 2015, the cleaning and excavation efforts in the area have continued under the supervision of the Nevşehir Museum Directorate in collaboration with the municipality (Arslan and Şıkoğlu, 2017).

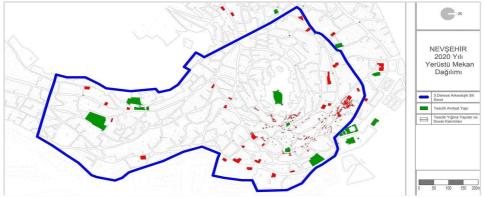


Figure 6. Archaeological site boundaries (Becerir, 2020)

During the urban clearance operations conducted in the historically rich fortress and its surroundings, numerous examples of vernacular architecture were demolished (Halaç and Eranıl, 2018; Özbay, 2024). In contrast to vernacular structures, monumental buildings were regarded as having significant tourism potential, particularly in conjunction with the underground city, leading to a more protective approach towards their preservation. As a result, by the time the fortress and its surroundings were designated as a protected archaeological site in 2014, the characteristic fabric of traditional vernacular architecture had largely been destroyed and degraded.

During the same period, urban clearance operations were also carried out in the Nevşehir Fortress and its immediate surroundings, as well as in the southern foothills of Kahveci Mountain (Figure 7).



Unfortunately, a significant portion of the vernacular architectural structures in this area had already suffered gradual deterioration over time, and the subsequent clearance efforts led to their complete destruction. Among the structures built by Orthodox Greeks, only the bell tower of Çanlı Church, the remains of the Greek Bath, and the Virgin Mary Church—which was used as a prison for some time—have survived to the present day.

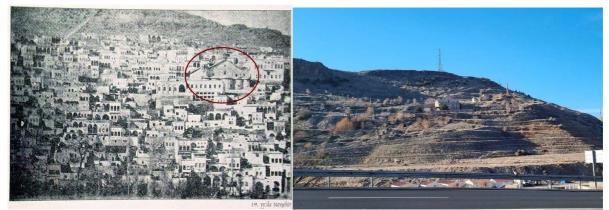


Figure 7. The Virgin Mary Church, 19th century (left) (URL-4) and view of the Virgin Mary

Church from Kahveci Mountain (right) (Aköz Çevrimli, 2025)

In 2019, the Ministry of Culture and Tourism initiated efforts to develop a new roadmap focused on quality and preservation to improve the current condition of Nevşehir Castle and its surroundings. In 2020, a Presidential Decree published in the Official Gazette officially designated Nevşehir Castle and its surroundings as a renewal area (URL-5). Following this, a strategic plan was prepared in 2020 to preserve and revitalize the area.

A team led by architects Han Tümertekin and Zehra Uçar, with the involvement of Aslı Özbay, developed a partial proposal in the strategic plan, adhering to the site's original fabric. Based on 1950s documentation and the 1964 plan, the traditional neighborhoods of Nevşehir were roughly modeled, and partial reconstruction proposals were made in accordance with the authentic urban fabric. Additionally, conservation proposals were introduced for the monumental structures in the area, including bezirhanes, churches, and burial chambers. A gathering space was proposed in the former Rüştiye Square to narrate the city's history, incorporating information displays, exhibitions, meeting areas, dining facilities, and rest spaces. With the approval of the strategic plan in 2021, the underground monumental structures were secured under protection. Following the strategic plan, 48 hectares of land were cleared, and a tour route was designed with newly proposed structures at three key points (Figure 8) (Özbay, 2024).





Figure 8. Reconstruction proposal developed by Han Tümertekin and his team (Özbay, 2024)

In 2020, the decision to designate Nevşehir Castle and its surroundings as a renewal area was made by a Presidential Decree. However, in 2021, this decision was annulled following a lawsuit filed by the Ankara Branch of the Chamber of Architects. The court ruling emphasized that opening such a multi-layered archaeological site to redevelopment and allowing physical interventions would lead to destruction and violate conservation principles (URL-6). Nevertheless, amendments to the Environmental Plan in 2023 reopened undeveloped areas for construction, shifting the focus from conservation to commercial gain. This approach has endangered both natural and cultural values. Although the strategic plan could not be implemented, it has served as a basis for the Conservation-Oriented Zoning Plan (Özbay, 2024).

In 2021, a restoration project was carried out, giving Nevşehir Castle a new appearance. Additionally, an environmental planning initiative was implemented to transform the area into a major attraction point (Figure 9).



Figure 9. Nevşehir Castle, left before restoration (URL-7), right after restoration and landscaping (URL-8)

The Meryem Ana Church, which is located in a dominant position overlooking the city, was opened for worship in 1849 and later used as a prison between 1950 and 1983, according to municipal archives (Kayaşehir Catalog, 2021). After remaining abandoned for nearly 40 years, the church underwent restoration and conservation efforts led by the Ministry of Culture and Tourism and was finally opened to visitors in 2023, contributing to tourism development (Figure 10).

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Figure 10. Virgin Mary Church, before restoration (left)(Kayaşehir Catalog, 2021), after restoration (right)(URL-9)

CURRENT SITUATION IN NEVSEHIR CASTLE AND ITS SURROUNDINGS

During the cleaning operations carried out in and around Nevşehir Castle, a rock-carved underground city was uncovered. This underground settlement spans 123,000 m² within a 437,400 m² Third-Degree Archaeological Site. In 2020, with the approval of the Presidency of Turkey, the area was designated for restoration and redevelopment under the "Preservation, Renewal, and Sustainable Use of Deteriorated Historical and Cultural Immovable Assets" provisions, aiming to integrate it into tourism.

Unfortunately, many above-ground structures, especially civil architectural examples, were demolished during the cleaning process. However, some religious structures, such as Kaya Cami and Kara Cami, have survived. Today, the area is primarily perceived as an underground city (Figure 11).



Figure 11. Rock-carved underground city, Kayaşehir (URL-10)

The structurally stable sections of the area have been opened to tourism, with necessary arrangements and adaptations made for visitors. However, this accessible part represents only a small fraction of the entire site (Figure 12). In sections lacking sufficient structural reliability, technical studies are ongoing in collaboration with a team formed in partnership with Nevşehir Hacı Bektaş Veli University.





Figure 12. Views from the underground city (Aköz Çevrimli, 2025)

On the southwest slope of the castle, a landscaping arrangement has been implemented, leaving large green lawn areas at the castle entrance and its inner sections (Figure 13). Additionally, the Kayaşehir VR Digital Experience Museum, designed in connection with this area, features visual representations of the underground spaces uncovered in the underground city, as well as a hot air balloon simulation area (Figure 14).



Figure 13. Nevşehir Castle landscaping (Aköz Çevrimli, 2025)



Figure 14. Kayaşehir VR Digital Experience Museum (Aköz Çevrimli, 2025)



On the western slopes of the castle, the Housing Development Administration of Turkey (TOKİ) held a tender on June 23, 2021, for the construction of a housing and commercial center within an area of approximately 34,000 m². This project includes 135 residential units, 18 shops, and a health center (Figure 15). The designated area is sharply separated from the 3rd-degree archaeological site, a division that has sparked significant debates regarding the preservation of traditional urban fabric and the historical identity of the region.



Figure 15. Residential and commercial centre planned in the area (URL-11)

It is evident that the interventions carried out under the name of "cleaning" in and around Nevşehir Castle, which led to the destruction of the historical fabric, have resulted in a significant loss in terms of urban identity. Although this project initially set out with the goal of a special design that aligns with the authentic architectural character of the area and reflects its historical and cultural values, the completed sections exhibit a standardized and homogeneous architectural language, diverging from the unique characteristics of local architecture (Figure 16).



Figure 16. Current status of the urban transformation project (Aköz Çevrimli, 2025)

On the other hand, the success of such projects should not only be measured by their architectural compatibility with local structures but also by their ability to establish a connection with the past and preserve the collective memory of the community.



This situation indicates that we are facing a process that overlooks the fact that the purpose of urban transformation is not merely structural renewal but also the preservation of local identity and cultural context. Unfortunately, the newly constructed buildings that have replaced the original historical structures fail to add value to the city—not only in terms of functionality but also in aesthetic and historical significance. Instead, they leave the impression of erasing the identity and historical traces of the place.

Following the urban clearance in Kahveci Dağı, the Virgin Mary Church, the Greek Bath, and the Bell Tower Church, which were originally built by the Orthodox Greeks, now appear as structures detached from their historical and cultural context. Today, only the bell tower of the Bell Tower Church, the remains of the Greek Bath, and the restored Virgin Mary Church have survived. At present, the Virgin Mary Church is open to visitors and is also used for social and cultural events (Figure 17).



Figure 17. A general view of the Meryem Ana Church and its use during an event (Çevrimli archive, 2024)

Hagios Georgios Church was built in 1797, while its bell tower was constructed in 1870 as a four-story structure. Over time, the church has suffered significant damage and deterioration. Although the bell tower has managed to survive, it appears that restoration efforts have not yet been undertaken (Figure 18).



Figure 18. Old church and bell tower on the left (Kayaşehir Catalog, 2021), present condition on the right (Aköz Çevrimli, 2025)



The Greek bath, built in 1892 and located at the upper level of Meryem Ana Church, is one of the few remaining structures from the Greek heritage. However, the bath has not fully preserved its structural integrity, and it appears that no restoration work has been carried out on this structure either (Figure 19).



Figure 19. Greek bath on the left (Kayaşehir Catalog, 2021), present condition on the right (Aköz Çevrimli, 2025)

This situation indicates that the few remaining monumental structures left within the area erased by the urban clearance process are also not adequately preserved. As a result, this leads to a significant loss in the city's historical continuity and collective memory. As of 2024, the highest point of Kahveci Dağı has been designated as a recreational area by the local government. Planned as a picnic area to meet the social needs of the local community, this space aims to transform the region's current use into a social focal point (Figure 20). This suggests that Kahveci Dağı, which historically bore traces of various cultures and was once known as a residential area, will now and in the future be remembered primarily as a recreational space.



Figure 20. Kahveci Mountain recreation area (Aköz Çevrimli, 2024)

Such planning poses significant risks in terms of preserving the historical identity and cultural heritage of the area. Kahveci Dağı, once an important settlement where different cultures coexisted, carries traces of the past. However, with the destruction of vernacular architecture and the new form of land use, these historical traces face the danger of being erased from memory.



Therefore, while this transformation may meet the social needs of the local community, it is considered a negative development in terms of the inability to preserve the region's historical and cultural fabric.

4. DISCUSSION AND CONCLUSION

The Nevşehir Castle and its surroundings have undergone numerous spatial transformations throughout history, with the 1924 population exchange and the 2009 urban transformation processes marking the most significant turning points. However, due to misguided interventions, unconscious usage, and political conflicts, the area's historical richness and multi-layered potential have not been fully revealed.

In multilayered cities, the most crucial step in preserving historical and cultural values is the timely and comprehensive execution of documentation and recording efforts. However, in the case of Nevşehir, the lack of adequate documentation prior to urban clearance activities has resulted in the loss of significant records concerning the area's historical past. Additionally, the removal of Nevşehir's city center from the tourism zone and the implementation of urban transformation projects under the municipality's initiative have led to the introduction of new designs that are incompatible with the historical fabric of the area. Consequently, this transformation has contributed to the erasure of the site's collective memory. Therefore, it is essential to adopt a holistic conservation approach for the area. As emphasized in Özbay (2024), partial reconstructions in areas deemed appropriate based on archaeological studies, within the framework of the conservation-utilization balance, could contribute to transforming the historical district into a living museum.

In the region where the traditional fabric and examples of civil architecture have largely been lost, the Kale (Citadel) and its surroundings today host strengthening efforts carried out by academic and technical teams, alongside a small number of monumental structures, an underground city, and areas opened to tourism. Although a visual connection between Atatürk Boulevard—the city's main axis—and the historical district surrounding the citadel is presumed to exist, the perceptibility and physical continuity of this connection remain quite weak. In this context, the establishment of pedestrianized areas and walking routes to enhance accessibility and visual perception between the city center and the historical district would be a significant step toward improving the area's legibility and accessibility.

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TASARIM SÜRECİNDE ESKİZ KULLANIMI VE DİJİTAL DÖNÜŞÜM

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ÖZET

İnsan yapımı nesnelerin tasarımında, görsel ve resimsel anlatımlar tarihsel bir gelenek olarak önemli bir yer tutmaktadır. Bu bağlamda soyut diyagramlar, fonksiyonel diyagramlar, eskizler, planlar, kesitler ve perspektif gibi çeşitli anlatım araçları tasarım sürecinin farklı aşamalarında kullanılmaktadır (Purcell & Gero, 1998). Özellikle tasarım sürecinin erken evrelerinde yapılanmamış resimsel anlatımlar olan eskizler, tasarımcılar ve mühendisler için kritik bir araç niteliğindedir. Sürecin ilerleyen aşamalarında ise daha yapılandırılmış görsel anlatımlar, örneğin plan ve kesitler, tasarımın gelişimine katkı sağlamaktadır.

Eskiz, kavramsal tasarım aşamasında en yaygın kullanılan yöntem olup, tasarımcıların fikir geliştirme sürecinde önemli bir keşif aracı olarak öne çıkmaktadır. Suwa ve Tversky'nin (1997, 2002a, 2002b) gerçekleştirdiği protokol analizleri, tasarımcıların eskizler yoluyla yeni fikirler keşfettiğini ve bu sürecin bilişsel katkılar sunduğunu ortaya koymuştur. Goldschmidt (2014) ise eskizin, tasarım sürecinde harici bir hafiza aracı olarak görev yaparak bilişsel yükü azalttığını vurgulamaktadır. Ayrıca, Verstijnen ve diğerleri (1998) eskizin, şekil manipülasyonu ve dönüşümlerine izin vermesi sayesinde daha karmaşık çözümleri desteklediğini belirtmektedir.

Endüstriyel tasarım, değişen kullanıcı ihtiyaçları ve teknolojik gelişmeler doğrultusunda sürekli evrim geçirmektedir. Bilgisayar destekli tasarım, sanal gerçeklik, artırılmış gerçeklik ve yapay zeka gibi yeni teknolojiler, tasarım sürecindeki eskizin rolünü yeniden şekillendirmektedir. Bu çalışma, söz konusu teknolojilerin tasarım pratiğindeki etkilerini değerlendirerek, eskizin gelecekteki konumunu ve bu teknolojilerin tasarım sürecine olası etkilerini analiz etmeyi amaçlamaktadır.

Anahtar Kelimeler: Eskiz, Bilgisayar Destekli Tasarım, Sanal, Gerçeklik, Yapay Zeka, Tasarım Süreci

SKETCHING IN THE DESIGN PROCESS AND DIGITAL TRANSFORMATION

ABSTRACT

Visual and pictorial narratives have an important place in the design of man-made objects as a historical tradition. In this context, various narrative tools such as abstract diagrams, functional diagrams, sketches, plans, sections and perspectives are used at different stages of the design process (Purcell & Gero, 1998). Especially in the early stages of the design process, sketches, which are unstructured pictorial narratives, are a critical tool for designers and engineers. In the later stages of the process, more structured visual narratives, such as plans and sections, contribute to the development of the design.

Sketching is the most widely used method in the conceptual design stage and stands out as an important discovery tool in the idea development process of designers. Protocol analyses conducted by Suwa and Tversky (1997, 2002a, 2002b) revealed that designers discover new ideas through sketches and that this process provides cognitive contributions. Goldschmidt (2014) emphasizes that sketching reduces cognitive load by acting as an external memory tool in the design process.



In addition, Verstijnen et al. (1998) state that sketching supports more complex solutions by allowing shape manipulation and transformations. Industrial design is constantly evolving in line with changing user needs and technological developments. New technologies such as computer-aided design, virtual reality, augmented reality and artificial intelligence are reshaping the role of sketching in the design process. This study aims to analyze the future position of sketching and the possible effects of these technologies on the design process by evaluating the effects of these technologies on design practice.

Keywords: Sketch, Computer Aided Design, Virtual Reality, Artificial Intelligence, Design Process



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ÖZET

Anastomozu değerlendirmek için en sık kullanılan yöntemler dijital rektal muayene (DRE), rijit veya fleksibl endoskopi (FE) ve kontrast lavman radyografidir. Ancak kolorektal anastomozun değerlendirilmesinde en uygun yöntemin hangisi olduğuna dair net bir fikir birliği yoktur. Amacımız bu olguda oblitere kolo-rektal anastomoz hattında izlenen hiperemik, enflame ve frajil görünümü, anastomoz hattından alınan biyopsi sonuclarını histolojik bulgular doğrultusunda sunmaktır. 74 yaşındaki erkek hasta Genel Cerrahi polikliniğine opere rektum kanseri (CA), anastomoz kontrolü amaçlı başvurmuştur. Hastanın perine muayenesi normal izlenmiş, tuşede 4-5. cm'de anastomoz hattı palpe edilmiştir. Fleksibl endoskopla girildiğinde, 4-5. cm'de oblitere görünümde kolo-rektal anastomoz hattı izlenmiştir. Remnant rektumda mukoza hiperemik, enflame ve frajil gözlenmiş ve bu alandan random biyopsiler alınmıştır. İşlem komplikasyonsuz sonlandırılmış, hastaya patoloji sonuçları ile poliklinik kontrolüne gelmesi önerilmiştir. Hastanın patolojik incelemelerinde makroskobik ve mikroskobik bulguları: en büyüğü 0,4x0,2x0,2 cm, en küçüğü 0,2x0,2x0,2 cm boyutlarında grimtrak renkte 3 adet doku parçası Hematoksilen & Eozin (H&E) ile boyanmış ve mikroskop altında incelendiğinde, inflame bağırsak örnekleri olarak tanımlanmıştır. Anastomoz güvenliğinden emin olmak için ameliyat sonrası kontroller mutlaka yapılmalı ve olası patolojiler göz ardı edilmemelidir.

Anahtar kelimeler: Rektum kanseri, anastomoz kontrolü, inflamasyon, histopatoloji.

OBLIQUE ANASTOMOTIC LINE IN AN OPERATED RECTAL CANCER PATIENT

ABSTRACT

The most commonly used methods to evaluate anastomosis are digital rectal examination (DRE), rigid or flexible endoscopy (FE) and contrast enema radiography. However, there is no clear consensus on the most appropriate method for the evaluation of colorectal anastomosis. Our aim in this case is to present the hyperemic, inflamed and fragile appearance of the obliterated colo-rectal anastomosis line and the biopsy results obtained from the anastomosis line according to histologic findings.



A 74-year-old male patient was admitted to the General Surgery outpatient clinic for operative rectal cancer (CA) anastomosis control. Perineal examination was normal and anastomosis line was palpated at 4-5th cm on palpation. When entered with a flexible endoscope, an obliterated colo-rectal anastomosis line was observed at 4-5 cm. In the remnant rectum, the mucosa was hyperemic, inflamed and fragile and random biopsies were taken from this area. The procedure was terminated without complications and the patient was advised to come to outpatient clinic control with pathology results. Macroscopic and microscopic findings in the pathologic examinations of the patient: 3 grayish colored tissue fragments, the largest measuring 0.4x0.2x0.2 cm and the smallest measuring 0.2x0.2x0.2 cm, were stained with Hematoxylin & Eosin (H&E) and when examined under the microscope, they were identified as inflamed intestinal specimens. Postoperative controls should be performed to ensure anastomotic safety and possible pathologies should not be ignored.

Keywords: Rectal cancer, anastomotic control, inflammation, histopathology.

GİRİŞ

Rektum kanseri, oldukça önemli bir tıbbi ve sosyal sorundur. Rektum kanseri, kolorektal kanserlerin % 30 kadarını oluşturmaktadır (1). Yüksek prevalansa sahip olmasına rağmen, optimal cerrahi, tıbbi ve radyo-onkolojik tedavisi henüz aydınlatılamamıştır (2). Günümüzde tedavinin transanal eksizyonl, lokal tedavi ve abdominoperianal rezeksiyon gibi çeşitli seçenekleri vardır (3). Cerrahi tedaviyi destekleyen kemoterapi ve radyoterapi, tanı alan hastaların daha iyi bir prognoza sahip olmalarını hedeflenmektedir. İmmünoterapi seçeneği de denenmiş olmasına rağmen, yeterli başarı elde edilememiştir.

Rektum kanseri, Gastrointestinal sistemin (GİS) farklı lokasyonlu bölgelerinde gelişen kanser türlerine göre daha yavaş seyirli ilerler. Bütün bu faktörler göz önüne alındığında cerrahi primer tedavi seçeneği olmuştur. Rektum cerrahisi yirmi birinci yüzyılın başından beri uygulanmakta ve sonuçları başarılı olmaktadır. Fakat lokal nüks oranları yüksek görülmektedir (1,2).

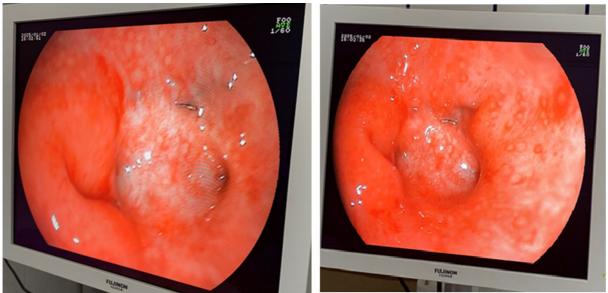
Anastomozu değerlendirmek için en sık kullanılan yöntemler dijital rektal muayene (DRE), rijit veya fleksibl endoskopi (FE) ve kontrast lavman radyografidir. Ancak kolorektal anastomozun değerlendirilmesinde en uygun yöntemin hangisi olduğuna dair net bir fikir birliği yoktur (4,5). Kontrast lavman radyografinin anastomoz bütünlüğünün rutin değerlendirmesindeki gerekliliği tartışmalıdır (6,7). Kontrastlı lavman radyografinin ardından DRE ile değerlendirilen hasta grubunun dahil edildiği bir prospektif çalışmada, DRE'nin anastomoz patolojisini saptamada %98,4 duyarlılığa sahip olduğu bildirilmiştir (8).

Amacımız bu olguda oblitere kolo-rektal anastomoz hattında izlenen hiperemik, enflame ve frajil görünümü, anastomoz hattından alınan biyopsi sonuçlarını histolojik bulgular doğrultusunda sunmaktır.

OLGU SUNUMU

74 yaşındaki erkek hasta Genel Cerrahi polikliniğine opere rektum CA, anastomoz kontrolü amaçlı başvurdu. Hastanın perine muayenesi normaldi, tuşede 4-5. cm'de anastomoz hattı palpe edildi. Fleksibl endoskopla girildi, 4-5. cm'de oblitere görünümde kolo-rektal anastomoz hattı izlendi. Remnant rektumda mukoza hiperemik, enflame ve frajil gözlendi, random biyopsiler alındı (Resim 1). İşlem komplikasyonsuz sonlandırıldı, hastaya patoloji sonuçları ile poliklinik kontrolüne gelmesi önerildi.

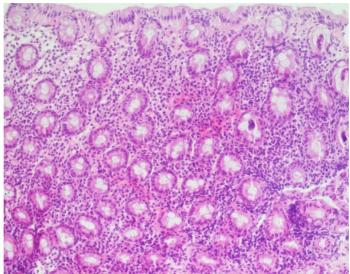
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Resim 1. Rektumda mukozasında hiperemik görünüm.

Hastanın patolojik incelemelerinde makroskobik ve mikroskobik bulguları:

En büyüğü 0,4x0,2x0,2 cm, en küçüğü 0,2x0,2x0,2 cm boyutlarında grimtrak renkte 3 adet doku parçası Hematoksilen & Eozin (H&E) ile boyanmış ve mikroskop altında incelendiğinde, inflame bağırsak örnekleri olarak tanımlanmıştır (Resim 2).



Resim 2. Rektumda inflamasyon (Boyama: Hematoksilen & Eozin).

TARTIŞMA

Rektum kanserlerinde obstrüksiyon, perforasyon veya konjesyon, cerrahi müdahalenin hızlandırılmasını gerektiren semptolar arasındadır. Özellikle obstrüksiyon en sık acil müdahale gerektiren ameliyat sebebidir (9). Non-rezektabl rektum kanseri tanısı multidisipliner bir ekip çalışmasını gerektirir. Non-rezektabl rektum kanseri, rektum kanserlerinin % 10-15'ini oluştururlar (10).



Bir çalışmada rektum kanserlerinde robotik aşağı anterior rezeksiyon daha uzun operasyon süresi ve daha az kan kaybı ile laparaskopik low anterior rezeksiyona benzer şekilde etkin ve güvenli bir şekilde uygulanabileceği bildirilmiştir (11). Tümörün alt sınırı ile anal verge arasındaki mesafe ve komşu organ tutulumu cerrahi prosedür seçimini belirlemektedir. Bizim hastamızda rektum kanseri tanısı ile opere edimiş ancak anastomoz hattının zamanla kapandığı izlenmiştir. Bu alandan alınan random biyopsilerin sonucu inflame bağırsak örnekleri olarak geldiğinden, inflamatuar hücrelerin tıkanıklığa neden olabileceği düşünülmüştür.

Kolorektal anastomozdaki en büyük devrim 1972'de Ravitch ve Steichen'ın cerrahi zımbaları tanıtmasıyla gerçekleşmiştir. %3,6'lık düşük bir sızıntı oranıyla kolorektal anastomozları kolaylaştırmıştır (12). <u>Kolorektal cerrahideki</u> en büyük zorluk ve en çok korkulan komplikasyonlardan biri <u>anastomoz kaçağı</u>dır (13-15). Anastomoz kaçağı ölümcül olmasa bile fizyolojik ve işlevsel olarak yıkıcıdır (16-18). Literatürlere göre görülme sıklığı %1,5 ile %28 arasında değişmektedir ve cerrahideki teknik ilerlemelere rağmen son on yıldır stabil kalmıştır. Anastomoz kaçağı, tüm postoperatif mortalitenin üçte birine kadarını oluşturabilir (13-15). Hastamızında anastomoz kontrolünü sağlamak için flexibl endoskopla incelendiğinde 4-5. cm'de oblitere görünümde kolo-rektal anastomoz hattı izlenmiş, ancak anastomoz kaçağı görülmemiştir.

2008 yılının sonu ve 2009 yılının başlarında başlatılan tarama çalışmalarında, Türkiye'de tanı alan kanserli 100.000 hastanın 280'i erkeklerde, 172'si ise kadınlarda görülmektedir. Bu rakamların üzerine her yıl yeni 170 bin kanser tanısı vakasının eklendiğini göstermektedir. Böylece veriler kabaca hesaplandığında kanser teşhisi almış ve yaşamını sürdüren toplam 350-400 bin kişi olduğu düşünülmektedir (19). Gelinen son nokta ise kanserin hem dünyada hem de ülkemizde 2015 yılından itibaren birinci sıradaki ölüm nedeni olacağı düşünülmektedir (20). Erkek ve kadınlarda görülen kanser türlerinin dağılımı farklılık göstermektedir. Dünyada, erkeklerde ilk üç sıra kanser türü, prostat, akciğer ve kolon iken, Türkiye'de bu sıralama akciğer, prostat ve mesane şeklinde olmaktadır. Kadınlarda ise ilk üç kanser türü Dünya'da meme, kolon ve akciğer kanseri iken, Türkiye'de sıralama meme, tiroid ve kolorektal kanseri şeklinde olmaktadır (19). Olgumuzda 74 yaşındaki erkek hastamız, rektum kanseri sebebi ile opere edilmiş olup, anastomoz kontrolü amacı ile polikliniğimize başvurmuştur.

SONUÇ

Sonuç olarak rektum kanserlerinin yavaş seyirli, uzun süre asemptomatik seyreden ölümcül sistemik bir hastalık olduğu söylenebilir. Günümüzde primer tedavisinin cerrahi olduğu herkes tarafından kabul görmektedir. İleri rektum kanseri tanısı olan hastalarda yaş, radyoterapi tedavisinin tamamlanamaması, postoperatif pozitif lenf nodu sayısı ve tümör derecesi ve adjuvan tedavi sağkalımı etkileyen faktörler olarak tanımlanmıştır. Anastomoz güvenliği göz ardı edilmemesi gereken en önemli faktördür. Bu nedenle anastomoz güvenliğinden emin olmak için ameliyat sonrası kontroller mutlaka yapılmalı ve olası patolojiler göz ardı edilmemelidir.

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ÖZET

Apendiksin malign neoplazileri son derece nadirdir ve yaşa göre ayarlanmış insidansı 1.000.000 kişi/yıl başına yaklaşık 0,12 olarak tahmin edilmektedir. Apendiksin primer malign neoplazileri arasında, sıklık sırasına göre; müsinöz adenokarsinom, kolonik-tip adenokarsinom, adenokarsinoid, malign karsinoid ve taşlı yüzük hücreli karsinom yer alır. Amacımız bu olguda nadir görülen kistik yapıdaki appendiks dokusunun adenokarsinom olarak değerlendirilmesi sonucu hastanın semptomlarını histolojik bulgular doğrultusunda sunmaktır. 59 yaşındaki erkek hasta apendektomi amacıyla ameliyata alındı. Ega sonrası göbeği dönen umblikus altı insizyon ile cilt-cilt altı tabakalar geçilerek batına girildi. Apendiks gövde kısmından erektil, ödemliydi ve çevre dokulara yapışıktı. Apendiks mukosel hali mevcuttu. Appendektomiye karar verildi. Apendiks kök kısmından echelon yardımıyla kesildi. Seri monte ıslak tamponlar ve aspirasyonla ile loj temizlendi. Takiben periton ve fasya 1 nolu loop pds ile unblok kapatıldı. Cilt altı- cilt kapatılarak operasyona son verildi. Ameliyat sonrası erken komplikasyon yaşanmamıştır. Hastanın kistik yapıdaki appendiks dokusu hem patolojik incelemelerinde hemde Bilgisayarlı Tomografisinde görüntülenmiştir. 8x6x5 cm boyutlarında krem-pembe renkli appendiks dokusuna kesi yapıldığında materyal icerisinde ver ver hematoien vasifta ver ver mukus kıvamında mavi cıkısı olduğu izlenmistir. Doku Hematoksilen & Eozin (H&E) ile boyanıp, mikroskop altında incelendiğinde ise; damar ile sinir invazyonunun olmadığı ancak, 5x4 cm ölçülerindeki tümörün Adenokarsinom olarak tanımlanmıştır. Apendiks adenokarsinomu için genellikle sağ hemikolektominin tercih edilmesi önerilmektedir.

Anahtar kelimeler: Apendiksin malign neoplazileri, adenokarsinom, apendektomi.



APPENDICEAL ADENOCARCINOMA: CASE REPORT

ABSTRACT

Malignant neoplasms of the appendix are extremely rare, with an age-adjusted incidence estimated at approximately 0.12 per 1,000,000 person-years. Primary malignant neoplasms of adenocarcinoma, appendix include mucinous colonic-type adenocarcinoma. the adenocarcinoid, malignant carcinoid and stony ring cell carcinoma, in order of frequency. Our aim in this case is to present the patient's symptoms in the light of histologic findings as a result of the evaluation of a rare cystic appendix tissue as adenocarcinoma. A 59-year-old male patient was operated for appendectomy. The abdomen was entered through the skinsubcutaneous layers with a sub-umbilicus incision. The appendix was erect, edematous and adherent to the surrounding tissues. Appendiceal mucocele was present. Appendectomy was decided. The appendix was cut from the root with the help of an echelon. The loin was cleaned with serial mounted wet tampons and aspiration. Subsequently, the peritoneum and fascia were closed unblock with loop pds number 1. The operation was terminated with subcutaneous-skin closure. There were no early postoperative complications. The cystic appendix tissue of the patient was visualized both in pathologic examinations and in Computed Tomography. When an incision was made in the 8x6x5 cm cream-pink colored appendix tissue, it was observed that some hematogenous and some mucus-consistency fluid outflow was observed in the material. When the tissue was stained with Hematoxylin & Eosin (H&E) and examined under the microscope; the tumor measuring 5x4 cm was defined as Adenocarcinoma without vascular and nerve invasion. Right hemicolectomy is generally recommended for adenocarcinoma of the appendix.

Keywords: Malignant neoplasms of the appendix, adenocarcinoma, appendectomy.

GİRİŞ

Apendikste görülen kötü huylu tümörler oldukça nadir rastlanılan bir durumdur. Yılda 1.000.000 kişi arasından kaşılaşma sıklığı sadece 1 olarak belirlenmiştir (1). Malign neoplaziler arasında karşılaşma sıklığına göre; müsinöz adenokarsinom, kolonik-tip adenokarsinom, adenokarsinoid, malign karsinoid ve taşlı yüzük hücreli karsinom gelmektedir (2). Apendiks malign neoplaziler ile mortalite oranı arasında önemli faktörler yer almaktadır. Bu faktörler ileri evrede tanı konulması, kolonoskopik incelemelerde izlenememesi, apendiks kanserlerini (AC), önemli kılmaktadır (3). AC'leri arasında üç alt tip vardır: müsinöz tip %55 görülme sıklığı ile genellikle sık rastlanılan tümörler olup, ikinci sırayı %34 oranı ile kolloid tipler ve son olarakta karsinoid tümörler (%11 oranında) yer almaktadır.

Apendiks tümörlerinin sıklıkla görülen semptomları arasında akut apandisit kliniği veya palpe edilebilen abdominal kitle yer almaktadır. Hastaların tanısı daha çok postoperatif dönemde konulmaktadır. Çünkü preoperatif genellikle semptomsuz ilerler (4). Akut apandisit kliniği ile başvuran hastalara apendektomi yapıldığında, patoloji raporları % 0,9-1,7 arasında tümör gelmektedir (5). apendiks kanserinde ileri yaşın bir risk faktörü olabileceği düşünülmüştür (6,7). Ancak yaş faktörü kesin olmayan ve diğer risk faktörlerinin göz ardı edilmemesi gereken bir durumdur. Daha spesifik faktörler arasında apendiks perforasyonu (8) ve başvuruda aneminin bulunması (9) gibi faktörler tanımlanmıştır. Müsinöz AC'ler çok sık rüptüre olur ve psödomiksoma peritonei (PMP) olarak adlandırılan duruma yol açar. Hipertermik intraperitoneal kemoterapi (HIPEC) ile sitoredüktif cerrahi (CRS), çeşitli epitelyal primerlerin yanı sıra apendiks tümörlerinden peritoneal yayılımın tedavisi için uygulanan yerleşik bir modalitedir (10,11).

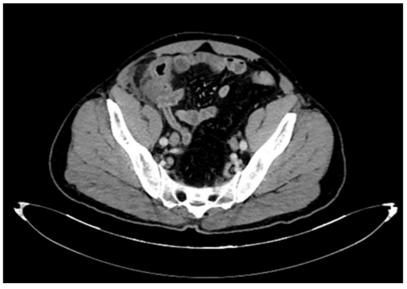


Apandisitin olağan patogenezi, apendiks lümeninin tıkanması olup, bu da intraluminal ve intramural basınçta artışa yol açar ve bu da küçük damar tıkanıklığına ve lenfatik staza, apendiksin gerilmesine, apendiks duvarı iskemisine ve nekrozuna ve tedavi edilmezse sonunda perforasyona neden olur (12).

Amacımız bu olguda nadir görülen kistik yapıdaki appendiks dokusunun adenokarsinom olarak değerlendirilmesi sonucu hastanın semptomlarını histolojik bulgular doğrultusunda sunmaktır.

OLGU SUNUMU

59 yaşındaki erkek hasta apendektomi amacıyla ameliyata alındı. Ega sonrası göbeği dönen umblikus altı insizyon ile cilt-cilt altı tabakalar geçilerek batına girildi. Explorasyon sonrası apendiks bulundu. Apendiks gövde kısmından erektil, ödemliydi ve çevre dokulara yapışıktı. Apendiks mukosel hali mevcuttu. Appendektomiye karar verildi. Apendiks mezodan klemp yardımıyla ve sıcak yıkama yapılarak ayrıştırıldı. Apendiks kök kısmından echelon yardımıyla kesildi. Seri monte ıslak tamponlar ve aspirasyonla ile loj temizlendi. Takiben periton ve fasya 1 nolu loop pds ile unblok kapatıldı. Cilt altı- cilt kapatılarak operasyona son verildi. Ameliyat sonrası erken komplikasyon yaşanmadı.

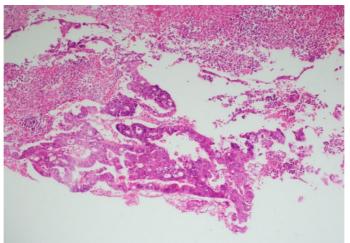


Resim 1. Hastanın abdomen Bilgisayarlı Tomografi görüntüsü. Kistik yapıda apendiks görünümü.

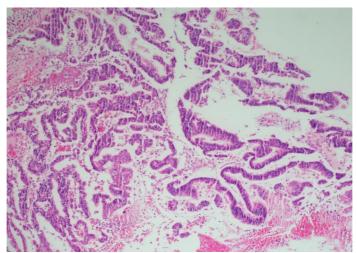
Hastanın patolojik incelemelerinde makroskobik bulguları: üzerinde 4 cm uzunluğunda stapler bulunan 8x6x5 cm boyutlarında krem pembe renkte genişlemiş kistik yapıda appendiks dokusu materyali olarak değerlendirildi. Materyale kesi yapıldığında materyal içerisinde yer yer hematojen vasıfta yer yer mukus kıvamında mayi çıkışı izlendi.

Hematoksilen & Eozin (H&E) ile boyanıp, mikroskop altında incelendiğinde ise; iyi diferansiye, damar ile sinir invazyonunun olmadığı ancak, 5x4 cm ölçülerindeki tümör Adenokarsinom olarak tanılandı (Resim 2). Cerrahi sınır ise negatif olarak değerlendirildi (Resim 3).





Resim 2. Adenokarsinom apendiks spesmeni.



Resim 3. Cerrahi sınırlar.

Hastanın ameliyat sonrası kan değerleri ise Tablo 1'de detaylı olarak verildi.

]	Tablo 1. Hastanın CEA, CA 125, CA 15-3 ve CA 19-9 değerleri.					
Tetkik Adı	Sonuç	Birim	Referans Aralığı/Karar Sınırı	Önceki Değerleri		
CEA	2.65	μg/L	Sigara içmeyen: 0-3 ng/mL Sigara içen: 0-7 ng/mL	8.75		
CA 125	21	U/ml	0-35	17.4		
CA 15-3	30.4	U/ml	0-31.3	23.1		
CA 19-9	23.5	U/ml	0-35	33.2		



TARTIŞMA

Apendiks kanseri çok nadirdir ve tipik olarak apendektomilerin yaklaşık %1'inde tesadüfi olarak bulunur (13). Ulusal Kanser Enstitüsü tarafından Sürveyans, Epidemiyoloji ve Son Sonuçlar (SEER) veri tabanı kullanılarak yayınlanan bir rapora göre, apandisal neoplazmlar gastrointestinal tümörlerin yaklaşık %0,4'ünü oluşturmaktadır (14). Primer apandis kanserleri nadir görülmekle birlikte, çok çeşitli histolojiye sahiptir. Karsinoidler yaklaşık %66'lık bir oranla en yaygın kanser türüdür; kist adenokarsinom %20 ve adenokarsinom %10'luk bir orana sahiptir (13). Bir de adenokarsinoid, taşlı yüzük, non-Hodgkin lenfoma gibi nadir görülen kanser türleri vardır. Toplam 7970 apendektomi örneğinde saptanan apendiks neoplazmlarının sıklığı Tablo 2'de gösterilmiştir (14).

Tablo 2: 7970 apendektomi örneğinde saptanan apendiks neoplazmlarının insidansı.

Apandis neoplazmi	N
Karsinoid	42
İyi huylu tümörler	
Müsinöz kistadenom	7
Villöz adenom	5
Kötü huylu tümörler	
Adenokarsinom	8
Lenfoma	1
Metastaz	11
Toplam	74

Apendiksin primer kanserlerinin büyük çoğunluğu ortalama tanı yaşı 38 olan malign karsinoid dışında 55-65 yaş arasındadır. Analiz edilen çalışmalara bağlı olarak, kadın/erkek oranı 3:1'den fazla olabilen malign karsinoid hariç, tüm apendiks neoplazmları için erkekler ve kadınlar eşit risk altında görünmektedir (14). Olgumuzda 59 yaşında olup, erkek hastadır. Apendektomi sonrası çıkarılan spesmen patoloji laboratuarına gönderilip ışık mikroskobu altında incelendiğinde hastamıza Adenokarsinom tanısı konuldu. Hastamızın adenokarsinom tanısı tesadüfi olarak bulundu.

Karsinoid tümörler ilk kez 1907 yılında Alman patolog Dr. Oberndorfer tarafından keşfedilmiştir. Dr. Oberndorfer ince bağırsakta bulduğu karsinoma benzeyen ama aynı zamanda iyi huylu adenomların özelliklerini de gösteren bir tümör topluluğunu karsinoid (karsinomalike) olarak tanımlamıştır (15). 1914 yılında Dr. Gosset ve Dr. Mason, karsinoid tümörlerin lamina propria ve submukozadaki bir tür nöroendokrin hücre olan enterokromaffin hücrelerinden oluştuğunu öne sürmüşlerdir. Bu hücreler vücudumuzdaki serotoninin yaklaşık %90'ını üretir ve içerirler (16). Karsinoidlerin çoğunun apendikste ortaya çıktığı kabul edilmektedir; ancak son veriler rektum ve ince bağırsak gibi diğer organlarda aslında daha yaygın olabileceğini düşündürmektedir. Mggard ve arkadaşları tarafından yapılan bir çalışmada 11.427 vaka analiz edilmiş ve tümörlerin %44,7'sinin ince bağırsakta, %19,6'sının rektumda, %16,7'sinin apendikste, %10,6'sının kolonda ve %7,2'sinin midede bulunduğu tespit edilmiştir (17). Olgumuzda izlenen tümör apendiks lokasyonludur.



Karsinoid tümörlerin insidansı ve prevalansı çelişkili istatistiklere sahiptir. Eski makalelerin çoğunda insidans 100.000'de bir ila iki olarak belirtilmiştir (18, 19). Daha yeni veriler insidansın bunun iki katı olabileceğini göstermektedir. İki verinin farklı olmasının sebebi hastalığın çoğunlukla asemptomatik olmasından ve uzun yıllar boyunca asemptomatik kalabilmesinden kaynaklanmaktadır, bu nedenle insidans oranının daha yüksek olması muhtemeldir.

SONUÇLAR

Apendiks kanserleri nadirdir. Çoğu apandisit nedeniyle yapılan apendektomilerde tesadüfen bulunur. İncelendiğinde tümörlerin çoğunluğu karsinoid, adenom ve lenfomadır. Apendiks adenokarsinomları tüm kanserlerin sadece %0,08'ini oluşturur ve tedavisi tartışma konularındandır. Apendiks adenokarsinomu için genellikle sağ hemikolektominin tercih edilen tedavi olduğu önerilir. Kemoterapinin rolü ise randomize çalışmaların eksikliği nedeniyle belirsizdir.

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EPİLEPSİ HASTALARINDA TELOMERAZ AKTİVİTESİNİN ÖLÇÜLMESİ VE OKSİDATİF/NİTROZATİF STRES'İN TELOMERAZ AKTİVİTESİYLE İLİŞKİSİ

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ÖZET

epilepsi hastalarında telomeraz aktivitesi, hTERT Bu çalışma, ekspresyonu ve oksidatif/nitrozatif stres parametreleri arasındaki ilişkiyi inceleverek, hastalığın patofizyolojisine yönelik mekanistik ipuçları sunmayı amaçlamaktadır. Araştırmada, epilepsi tanılı bireylerden ve sağlıklı kontrollerden alınan serum örneklerinde telomeraz aktivitesi, hTERT düzeyi, indüklenebilir Nitrit Oksit Sentaz (iNOS), NADPH oksidaz (NOX), 3-Nitrotirozin (3-NT) ve nitrik oksit (NO) gibi parametreler ile total ve native thiol konsantrasyonları ELISA ve spektrofotometrik yöntemlerle analiz edilmiştir. Elde edilen bulgulara göre, epilepsi grubunda telomeraz aktivitesi ve hTERT düzevleri, sağlıklı kontrol grubuna kıyasla anlamlı derecede düşüktür. Buna karşılık, 3-NT, iNOS, NOX ve NO düzeylerinde belirgin artış gözlenmiş, total ve native thiol seviyeleri ise düşük çıkmıştır. Bu sonuclar, epileptik bevinde kronik oksidatif ve nitrozatif stresin telomeraz aktivitesini baskıladığını, antioksidan savunma sistemini tükettiğini ve nörodejeneratif süreçleri hızlandırdığını göstermektedir. Ayrıca, çalışmada NOX ve iNOS kaynaklı reaktif oksijen ve azot türlerinin (ROS/RNS) sinerjistik etkisiyle oluşan peroksinitrit (ONOO⁻) birikiminin hem telomerik DNA'ya hem de telomeraz bileşenlerine zarar verdiği vurgulanmıştır. Düşük thiol düzeyleri, redoks dengesinin bozulduğunu ve nöronal hasarın şiddetlendiğini işaret etmektedir. Bu bulgular, kronik durumlarda sıklıkla gözlenen telomeraz disfonksiyonu ile benzerlik göstermekte olup, epilepside de telomerik instabilite ile oksidatif stresin birbirini tetikleyen ve hastalığın progresyonunda önemli rol oynayan patolojik bir eksen oluşturduğunu düsündürmektedir.



Bu çalışma, epilepsi patofizyolojisinde oksidatif stresin ve telomeraz disfonksiyonunun etkilerini ortaya koyarak, gelecekte geliştirilebilecek terapötik stratejiler için yeni araştırma alanları açmaktadır.

Anahtar Kelimeler: Telomeraz, hTERT, oksidatif stres, epilepsi, 3-Nitrotirozin, NADPH oksidaz.

MEASUREMENT OF TELOMERASE ACTIVITY IN EPILEPSY PATIENTS AND THE RELATIONSHIP BETWEEN OXIDATIVE/NITROSATIVE STRESS AND TELOMERASE ACTIVITY

ABSTRACT

This study aims to provide mechanistic clues to the pathophysiology of the disease by examining the relationship between telomerase activity, hTERT expression, and oxidative/nitrosative stress parameters in epilepsy patients. In this study, telomerase activity, hTERT level, parameters such as inducible Nitrite Oxide Synthase (iNOS), NADPH oxidase (NOX), 3-Nitrotyrosine (3-NT), and nitric oxide (NO), and total and native thiol concentrations were analyzed by ELISA and spectrophotometric methods in serum samples obtained from individuals with epilepsy and healthy controls. According to the findings, telomerase activity and hTERT levels were significantly lower in the epilepsy group compared to the healthy control group. In contrast, 3-NT, iNOS, NOX, and NO levels were significantly increased, while total and native thiol levels were low. These results suggest that chronic oxidative and nitrosative stress suppresses telomerase activity, depletes the antioxidant defense system, and accelerates neurodegenerative processes in the epileptic brain. Furthermore, the study emphasized that peroxynitrite (ONOO-) accumulation caused by the synergistic effect of NOX- and iNOS-induced reactive oxygen and nitrogen species (ROS/RNS) damages telomeric DNA and telomerase components. Low thiol levels indicate that redox balance is disrupted and neuronal damage is exacerbated. These findings are similar to the telomerase dysfunction frequently observed in chronic conditions and suggest that telomeric instability and oxidative stress form a pathological axis in epilepsy that triggers each other and plays an important role in disease progression. This study reveals the effects of oxidative stress and telomerase dysfunction in the pathophysiology of epilepsy and opens new research areas for future therapeutic strategies.

Keywords: Telomerase, hTERT, oxidatif stress, epilepsy, 3-Nitrotyrosine, NADPH oxidases.



HASTANE YÖNETİMİNDE YAPAY ZEKA KULLANIMI

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ÖZET

Hastane yönetiminde yapay zeka (YZ) kullanımı, sağlık hizmetlerinin kalitesini artırmak, verimliliği artırmak ve maliyetleri düşürmek için önemli bir araç haline gelmiştir. YZ, büyük veri analizi, makine öğrenimi ve doğal dil işleme gibi teknolojilerle, hastane yönetiminin farklı alanlarında devrim yaratmaktadır.

Öncelikle, yapay zeka hastaların tedavi süreçlerinde önemli bir rol oynamaktadır. YZ destekli sistemler, hastaların tıbbi geçmişini ve semptomlarını analiz ederek doğru tanılar koymaya yardımcı olabilir. Ayrıca, tedavi süreçlerinin kişiselleştirilmesine olanak tanır, böylece hastaların daha hızlı iyileşmesi sağlanabilir. YZ algoritmaları, hastaların medikal geçmişi ve genetik verilerini inceleyerek en uygun tedavi planlarını önerir.

Hastane yönetiminde YZ'nin bir diğer önemli uygulaması, kaynak yönetimidir. Hastaneler genellikle yoğun hasta yükü, sınırlı personel ve tıbbi ekipmanla başa çıkmaya çalışır. YZ, hastaların kabulü, yatak kullanımı ve tıbbi malzeme talepleri gibi süreçleri analiz ederek kaynakların daha verimli kullanılmasını sağlar. Bu sayede, gereksiz maliyetler düşürülebilir ve hastalar için daha etkili bir hizmet sunulabilir.

YZ, ayrıca sağlık personelinin iş yükünü hafifletir. Otomatikleştirilmiş hasta takibi, raporlama ve envanter yönetimi gibi süreçler, sağlık çalışanlarının daha fazla vakitlerini hasta bakımına ayırmalarını sağlar. Ayrıca, yapay zeka destekli chatbot'lar ve sanal asistanlar, hastaların randevu alması, ilaç kullanımı hakkında bilgi alması veya sorularını sorması gibi işlemleri kolaylaştırır.

Sonuç olarak, hastane yönetiminde yapay zeka kullanımı, hem hasta bakımını iyileştirir hem de operasyonel verimliliği artırır. Bu teknoloji, gelecekte daha fazla hastane ve sağlık kuruluşu tarafından benimsenerek sağlık hizmetlerinin kalitesini ve erişilebilirliğini yükseltecektir.

Anahtar Kelimeler: Yapay Zeka, Hastane, Sağlık

USE OF ARTIFICIAL INTELLIGENCE IN HOSPITAL MANAGEMENT

SUMMARY

The use of artificial intelligence (AI) in hospital management has become an important tool for improving the quality of healthcare, increasing efficiency, and reducing costs. With technologies such as big data analysis, machine learning, and natural language processing, AI is revolutionizing different areas of hospital management.

First of all, artificial intelligence plays an important role in the treatment process of patients. AI-powered systems can help make accurate diagnoses by analyzing patients' medical history and symptoms. It also allows for personalized treatment processes, so that patients can recover faster. AI algorithms recommend the most appropriate treatment plans by examining patients' medical history and genetic data.

Another important application of AI in hospital management is resource management. Hospitals often struggle to cope with a high patient load, limited staff and medical equipment.



AI analyzes processes such as patient admission, bed usage and medical supply requests, enabling more efficient use of resources. This can reduce unnecessary costs and provide more effective service for patients.

AI also reduces the workload of healthcare personnel. Automated processes such as patient tracking, reporting, and inventory management allow healthcare professionals to spend more time on patient care. Additionally, AI-powered chatbots and virtual assistants make it easier for patients to make appointments, get information about medication, or ask questions.

As a result, the use of AI in hospital management improves patient care and operational efficiency. This technology will be adopted by more hospitals and healthcare organizations in the future, increasing the quality and accessibility of healthcare services.

Keywords: Artificial Intelligence, Hospital, Health



DÜNYADA DOĞUM ORANLARININ DÜŞÜŞ NEDENLERİ

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ÖZET

Dünyada doğum oranlarının düşüşü, günümüzde birçok ülkede gözlemlenen önemli bir demografik değişimdir. Bu düşüşün sebepleri, ekonomik, sosyal ve kültürel faktörlerin bir kombinasyonundan kaynaklanmaktadır. Doğum oranlarındaki azalma, ülkelerin nüfus yapıları üzerinde uzun vadede ciddi etkiler yaratabilir.

Ekonomik faktörler, doğum oranlarındaki düşüşün başlıca sebeplerindendir. Özellikle gelişmiş ülkelerde yaşam maliyetlerinin yüksekliği, bireylerin çocuk sahibi olma kararını ertelemesine veya sınırlamasına yol açmaktadır. Konut fiyatları, eğitim masrafları ve sağlık giderleri, ailelerin çocuk sahibi olma konusunda daha temkinli olmalarına neden olmaktadır. Ayrıca, iş gücüne katılımı artan kadınlar, kariyerlerini önceleyerek çocuk sahibi olma yaşını erteleme eğilimindedir.

Sosyal ve kültürel değişiklikler, aile yapısı, dünya görüşleri doğum oranlarını etkileyen önemli faktörlerdir. Kadınların eğitim seviyelerinin artması, evlilik yaşının yükselmesi ve toplumsal normların değişmesi, aile kurma kararlarını etkilemektedir. Çiftler, daha geç yaşlarda evlenmeye ve çocuk sahibi olmaya başlamaktadır. Ayrıca, evlilik dışı birlikteliklerin yaygınlaşması da doğum oranlarının düşmesinde rol oynamaktadır.

Teknolojik gelişmeler ve aile planlaması yöntemlerinin artması, istenmeyen gebeliklerin önlenmesini kolaylaştırmış, çiftlere daha bilinçli seçimler yapma imkânı sunmuştur. Ayrıca, çevresel faktörler de doğum oranlarını etkileyebilir. İklim değişiklikleri ve çevresel tehditler, bireyleri çocuk sahibi olma konusunda daha temkinli olmaya itebilir.

Sonuç olarak, dünyadaki doğum oranlarındaki düşüş, ekonomik zorluklar, kadınların iş gücüne katılımı, toplumsal değişiklikler ve çevresel faktörlerin birleşimiyle şekillenmektedir. Bu durum, gelecekteki nüfus yapısını önemli ölçüde etkileyebilir.

Anahtar Kelimeler: Gebelik, Ekonomi, Doğum Oranı

REASONS FOR DECLINING BIRTH RATES IN THE WORLD

SUMMARY

The decline in birth rates worldwide is a significant demographic change observed in many countries today. The reasons for this decline are due to a combination of economic, social and cultural factors. The decline in birth rates can have serious long-term effects on the population structure of countries.

Economic factors are the main reasons for the decline in birth rates. Especially in developed countries, high living costs cause individuals to postpone or limit their decision to have children. Housing prices, education costs and healthcare costs cause families to be more cautious about having children. In addition, women who are increasingly participating in the workforce tend to postpone the age of having children in order to prioritize their careers.

Social and cultural changes, family structure, and worldviews are important factors affecting birth rates. The increase in women's education levels, the increase in the age of marriage, and the change in social norms affect family formation decisions.



Couples are getting married and having children at later ages. In addition, the prevalence of extramarital affairs also plays a role in the decrease in birth rates.

Technological advances and the increase in family planning methods have made it easier to prevent unwanted pregnancies and have given couples the opportunity to make more informed choices. Environmental factors can also affect birth rates. Climate change and environmental threats can push individuals to be more cautious about having children.

Ultimately, the decline in global birth rates is driven by a combination of economic hardship, female labor force participation, societal changes, and environmental factors that could significantly impact future demographics.

Keywords: Pregnancy, Economy, Birth Rate



THE ROLE OF IMMUNOHISTOCHEMICAL STAINING IN THE DETECTION OF STEM CELLS IN THE HUMAN PLACENTA

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Introduction

The study of human placenta structures, especially stem cells and their differentiation potential, opens up new perspectives in many areas of medical science - regenerative medicine, oncology and genetic research. Methods for determining stem cells create conditions for a deeper study of the biomolecular properties of the human placenta and the discovery of the therapeutic potential of these structures.

Stem cells present in the human placenta have a high differentiation potential and are widely used in research. These cells are located in structures of both maternal and fetal origin. The main mesenchymal stem cells located in different parts of the human placenta are located in the stroma of the human placenta, amniotic membrane, and chorionic cavities, and have been reported to have the ability to differentiate into osteogenic, chondrogenic and adipogenic. Hematopoietic stem cells form the vascular endothelium of the chorion and human placenta, and are involved in the formation of blood cells, trophoblastic stem cells consist of cytotrophoblast and syncytiotrophoblast cells, and are involved in the formation and implantation of the human placenta, and amniotic epithelial stem cells are located in the epithelial cells of the amniotic membrane, showing both embryonic and mesenchymal characteristics.

Specific immunohistochemical markers are used to identify stem cells. Many universal markers are used by immunohistochemical staining methods, including CD73, CD90, CD105, CD34, CD45, Cytokeratin 7, HLA-G, OCT4, SOX2, NANOG. The detection of each of these markers in placental tissue depends on the correct collection of tissue, fixation, adherence to staining protocols, and of course, the health of the tissue.

Keywords: Cytotrophoblast, immunohistochemistry, placenta, CD.

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FRANSIZ KONTRAST METODUNUN PATLAYICI GÜCÜ ARTTIRMADAKİ ROLÜ

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ÖZET

Bu çalışma, Fransız kontrast metodunun (FCM), sporcularda patlayıcı gücü arttırmadaki rolünü incelemeyi amaçlamaktadır. Patlayıcı güç, sinir-kas sisteminin etkin çalışmasını sağlayarak spor performansını doğrudan etkileyen önemli bir faktördür. Güç, hız, sıçrama ve patlayıcı kuvvet gibi faktörler, özellikle yüksek performans gerektiren spor dallarında, atletlerin başarılarını doğrudan etkilemektedir. FCM, post-aktivasyon potansiyasyonu (PAP) temeline dayanan ve yüksek yoğunluklu direnç egzersizleri ile patlayıcı hareketlerin sırasıyla uygulanmasını içeren antrenman yöntemidir.

Araştırmada, FCM'nin patlayıcı güç üzerindeki etkileri mevcut literatür doğrultusunda incelenmiş ve değerlendirilmiştir. Elde edilen bulgular, FCM uygulamalarının organizmadaki motor ünite aktivasyonunu artırarak kas-tendon sertliğini ve güç üretim hızını daha verimli hale getirdiğini göstermektedir. Bu süreç, kuvvet ve hız temelli hareketlerin ardışık olarak uygulanmasıyla, sinir-kas adaptasyonlarını iyileştirerek sporcuların patlayıcı güçlerini artırmalarını sağlamaktadır. Ayrıca, FCM'nin kas liflerinin hızlı aktivasyonunu destekleyen sinirsel ve mekanik adaptasyonları geliştirdiği ve atletik performansın artmasına olumlu etki ettiği tespit edilmiştir.

Sonuç olarak, Fransız kontrast metodu uygulamalarının sporcularda patlayıcı gücü arttırmada etkili bir antrenman metodu olduğu söylenebilir. Ayrıca, kas liflerinin hızlı aktivitelerini sağlayabilmek için gerekli mekanik ve sinirsel adaptasyonlar üzerine de olumlu etkilerinin olduğu görülmektedir. Bu sonuçlara göre, FCM'nin sporcuların patlayıcı güçlerini geliştirmede önemli bir araç olabileceği ve gelecekte daha geniş çaplı uygulamalara yönelebileceği söylenebilir.

Anahtar Kelimeler: Fransız Kontrast Metodu, Patlayıcı güç, Atletik performans.

THE ROLE OF THE FRENCH CONTRAST METHOD IN ENHANCING EXPLOSIVE POWER

ABSTRACT

This study aims to examine the role of the French Contrast Method (FCM) in enhancing explosive power in athletes. Explosive power is a fundamental factor that directly influences sports performance by optimizing the efficiency of the neuromuscular system. Attributes such as strength, speed, jump height, and explosive force are pivotal in high-performance sports, as they directly contribute to an athlete's success. The French Contrast Method (FCM) is a training modality based on the principles of post-activation potentiation (PAP), which involves the sequential application of high-intensity resistance exercises followed by explosive movements.

The effects of FCM on explosive power were systematically reviewed and analyzed in light of the current literature. The results indicate that FCM interventions facilitate enhanced motor unit activation, increase muscle-tendon stiffness, and improve the rate of force production, thereby optimizing neuromuscular efficiency.



The sequential application of strength- and speed-based exercises further enhances neuromuscular adaptations, which in turn leads to significant improvements in explosive power. Additionally, FCM was found to promote neural and mechanical adaptations that support the rapid activation of muscle fibers, thereby contributing to a marked improvement in athletic performance.

In conclusion, the French Contrast Method is an effective training protocol for enhancing explosive power in athletes. Moreover, it exerts positive effects on the requisite mechanical and neural adaptations necessary for rapid muscle fiber activation. These findings suggest that FCM can be a valuable tool in the development of explosive power in athletes, with potential for broader application in future training programs.

Keywords: French Contrast Method, Explosive power, Athletic performance.



IMPACT OF IRRIGATION WITH TRICKLING FILTER-TREATED WASTEWATER ON MILLET CULTIVATION AND SOIL FERTILITY IN SEMI-ARID NORTH AFRİCA

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Abstract

The goal of this work was to investigate the effect of treated wastewater irrigation on the physiological and agronomic properties of Millets area major source human food and are an excellent source of all essential nutrients like protein ,carbohydrates, fat, minerals,and bioactive compounds. An experimental reuse study was performed using raw (RWW) and treated urban wastewater (TWW) by Trickling Filter (TF) process to irrigate Millet in comparison to well water (WW) as a control over a period of 5 months. The water quality was determined for irrigation based on sodium adsorption ratio (SAR), sodium percentage (Na %) and residual sodium carbonate (RSC) indicating that all treatments were suitable for irrigation purposes. In this study, we also assessed the agro-physiological and biochemical proprieties of the crops. Hence, the highest productivity of millet and leaf area were obtained in response to irrigation with RWW and TWW compared to WW; while macro-elements (TP, TKN, and K) were also affected in millet irrigated with RWW compared to TWW and WW. However, the plants irrigated with well water accumulate more Ca, Na, and Mg than those irrigated with RWW and TWW. All the crops irrigated with three water treatments showed a relatively similar concentration of micro-nutriments. The prevalence of total chlorophyll content in the plants increased with well water irrigation. Nevertheless, the biochemical parameters (protein and sugar content) were adversely affected in millet irrigated with RWW as compared to TWW and WW. Moreover, the use of treated urban wastewater improves the physicochemical properties and fertility of the soil compared to well water and enhances crop productivity.

Keywords: *Millet;* irrigation; treated wastewater reuse; physiological proprieties; Trickling Filter.

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1.Introduction

Water is crucial for the development of crops. It is regarded as one of the most significant factors affecting agricultural yields. To meet plant water requirements and prevent water stress, which affects plant physiological and morphological processes and lowers crop yields, crop production needs a constant supply of water (Sadras et al., 2016). Although municipal wastewater is usually applied as a source of irrigation water for crops, it is also a source of nutrients (macronutrients N, P, K, Ca, Mg and micronutrients Fe, Zn, Cu, Mn....), that are essential for both soil and plant nutrition (Rezapour et al., 2021). However, the nutrient content of wastewater can exceed plant needs. It can also cause excessive vegetative growth, lowering the quality of irrigated crops. Therefore, the concentration of nutrients is present in the treated municipal wastewater as part of the fertilization program for irrigated crops. The concentration of nutrients as well as toxic metals content in wastewater depends upon on the water supply, the type and degree of wastewater treatment, and the quality of the wastewater. Mohsin et al. (2021) find a significant accumulation of N and P by two willow cultivars, including Salix schwerinii and Klara irrigated with WW under greenhouse conditions. Furthermore, the study showed a very low metal concentration in soils after growth season. The proportion of nutrients recovered varies greatly and is contingent on the nutrient concentration in wastewater, nutrient loading, the timing of application and harvesting intervals, the ability of plant species for nutrient uptake, and accumulation in aboveground biomass (Tzanakakis et al., 2009). Usually, for the treatment process, each stage reduces the concentration of both N and P. In this regard, wastewater should be monitored at least once at the beginning of the agricultural season (FAO, 2003). Farmers always have access to water for crop irrigation because wastewater is climate-independent (unlike rain), even during droughts (Verlicchi et al., 2012). By preserving ideal soil moisture on their farms and fields, farmers can produce stable, greater agricultural yields throughout the year (Ouda et al., 2016). Often, wastewater reuse generates enough water to satisfy irrigation needs. Farmers may gain more finance from this, particularly in arid and semi-arid countries such as Morocco. Despite the beneficial effects of wastewater reuse on soil and plant growth due to the availability of nutrients with easy uptake (Vergine et al., 2017), there is significant worry about its negative environmental effects and health hazards to the environment (Jiries et al., 2009). Recovery and reuse of wastewater are typically described in terms of standards that have been published or are suggested by regional authorities or international organizations. To meet those standards, wastewater must be treated before it is used for irrigation.

Several technologies, including physical (Combined sewer overflow in urban watersheds) (Gasperi et al., 2012); electrochemical (Electrochemical Oxidation) (Murthy et al., 2011); and biological technology such as (Activated sledge, constructed wetland, multi-soil-layering) (El Moussaoui et al., 2019; Elfanssi et al., 2018; Zidan et al., 2022) processes of them has been applied to remove effectively compounds from wastewater. However, when the aim is to use the wastewater again for crop use, early elimination of organic particles and nutrients from the wastewater is frequently unsuitable. Preserving organic particles as well as some nutrients like N and P can be interesting and advantageous for soil and plants (Ahmali et al., 2020). The existing urban wastewater treatment technologies are not efficient in removing organic particles and nutrients, so it is necessary to investigate a novel wastewater treatment and reuse technology that can be both selective and ecologically safe.

The Trickling Filter (TF) system is an innovative and cost-effective technology that requires simple maintenance. It functions by using a porous medium to filter wastewater, serving as both a physical filter and a platform for aerobic and anaerobic biological reactions.



The TF system is specifically designed for secondary treatment of wastewater (Song et al., 2020). The arrangement of soil mixture layers, including soil, sawdust, charcoal, and iron particles, in alternating bricks with gravel layers prevents clogging issues (An et al., 2016; Zidan et al., 2023). This system is a practical solution for wastewater treatment in small communities and offers several advantages (An et al., 2016). Numerous studies highlight the effectiveness of the TF system in treating various types of wastewater worldwide, positioning it as an emerging technology (Sbahi et al., 2022). Furthermore, current research focuses on enhancing the TF technology by investigating the removal of conventional pollutants. However, despite the extensive exploration of the TF field, no studies have demonstrated the benefits of using TF technology-treated domestic wastewater in agriculture.

Numerous studies have investigated the impacts of both raw and treated wastewater on soil properties and plant agronomic characteristics. One approach to enhance soil fertility and increase crop yield is through the utilization of effective soil amendments, such as carbon-rich materials (Dai et al., 2014; Jin et al., 2019). Preserving organic matter and essential nutrients like N and P can also have beneficial impacts on both soil and plants (El Moussaoui et al., 2017).

Abegunrin et al. (2013) conducted a study in southwestern Nigeria to examine the effects of kitchen wastewater, rainwater, and groundwater irrigation on cucumber (*Cucumis sativus*) growth parameters and soil properties. They found that while there were some negative effects on cucumber growth parameters, the soil condition was not significantly impacted by the use of kitchen wastewater compared to groundwater or rainwater. Pereira et al. (2011) investigated the impacts of increasing wastewater irrigation rates on soil properties under tropical conditions. Their findings revealed a reduction in soil acidity in areas irrigated with urban wastewater. Furthermore, research conducted by Kouraa et al. (2002) in Morocco demonstrated a clear improvement in crop production for potatoes and lettuce when irrigated with treated wastewater.

However, several researchers have investigated the profound impact of domestic wastewater, whether it is raw or processed, on the physiological characteristics of crops. In their study, Castro et al. (2013) investigated the impact of using treated domestic wastewater for irrigating lettuce (Lactuca sativa L.) on soil properties and the lettuce crop. The researchers observed that the primary adverse effect of employing treated wastewater was the elevation of salt and sodium levels in the soil. In the same context, Abegunrin (2013) reported the effects of irrigation with treated groundwater, rainwater, and kitchen wastewater on soil properties and cucumber (Cucumis sativus) growth characteristics. It was found that the use of kitchen wastewater had no harmful effects on soil quality compared to rainwater and groundwater. However, there were some adverse effects on the growth indices of cucumbers. The study done by Munir et al. (2007) examined the effects of long-term sewage irrigation on soil properties and crop quality parameters and found that irrigation had an important effect on both the soil and crop parameters. According to Kouraa et al. (2002), TWW reuse clearly improves the culture yield of lettuce and potatoes. Global cereal production reached a record 2715 million tonnes in 2019, yet challenges like population growth, climate change, water scarcity, and resource limitations threaten food security by reducing yields and raising prices. To address this, millet emerges as a resilient, nutrient-rich alternative, particularly suited to arid regions in Africa and Asia. As the sixth-largest cereal crop, millet production hit 31 million tonnes in 2018, led by India, with over 96% grown in Africa and Asia. Despite fluctuating yields and harvested areas, cultivation has rebounded since 2015, underscoring its potential to bolster dietary needs amid global agricultural pressures.



The main objective of this work is to evaluate the impact of irrigating treated wastewater using a trickling filter (TF) technology on the physicochemical properties of soil and the agro-physiological characteristics of millet cultivated in an arid climate. The planned specific objectives are: 1) to evaluate the physicochemical and microbial parameters of water and soil irrigated with raw wastewater (RWW), treated wastewater (TWW), and well water (WW) to determine their suitability for irrigation and potential impacts on soil quality; 2) to assess the agro-physiological characteristics of millet crops irrigated with RWW, TWW, and WW, focus-ing on parameters such as biomass parameters, nutrient content, and accumulation of protein and sugar contents, to understand the effects of different water qualities on crop growth and productivity; 3) to determine the potential of treated wastewater, processed using the trickling filter technology, as a source of plant nutrients and soil fertilizers, aiming to reduce the need for additional fertilizer application, improve soil fertility, and enhance the productivity of poorly fertile soils

2.Material and methods

2.1.Experimental set-up

The effect of processed wastewater on soil properties and the agro-physiological properties of millet was investigated under arid conditions in three separate pot experiments. Millet is a monoecious annual herbaceous plant from the grass family. It comes from North America. It is a leguminous plant, with good nutritional quality, and high protein content, is more cultivated in the world, and also benefits soil fertility (Harbouze et al., 2019). The experiment site is Imintanoute (Marrakech, Morocco). This region has an arid climate, with an average annual rainfall of 240 mm. Urban wastewater was treated with TF plant, which has been implemented at the university since 2016 (Zidan et al., 2022; 2023). A test field is established across from the TF hybrid and is designated for the cultivation of three plots (P1, P2, and P3), each measuring $(3.65 \text{ m} \times 2.5 \text{ m})$ and separated by a 3m alley, each plot divided into four lines with 10 replications (Figure 1). In total, three types of irrigation water were used to irrigate 120 corn trees: RWW, TWW, and WW. Irrigation was applied twice weekly to keep moisture content levels in the three plots under study at 60% of field capacity, as suggested for arid regions with high temperatures based on prior studies (Nasta et al., 2023). This reduced saturation level, which is controlled by air temperature, has been found to boost millet growth, according to Xiong et al. (2020). The experiment was carried out in 2023, from March through July, which is a hot season of the year in Marrakech. The irrigation technique employed was drip irrigation, and each irrigation treatment required 93 l of water per plot.



Figure 1. Experimental setup of the millet plants, irrigated by the three water treatments (RWW: raw wastewater (A); TWW: treated wastewater (B); Well water: WW (C))



2.2. Water sampling and analyses

Water samples were collected from the inlet and outlet of the wastewater treatment plant TF which represent, respectively, RWW and TWW. For WW, it was taken from the tap connected with the well water. The depth of the well exceeds 55 m, and it is protected from all the activities nearby. Ten samples were taken from each irrigation water source from March to July. They were stored in sterile glass bottles for physicochemical analysis. The bottles were transported in a cooler at a temperature of 4 °C to the analysis laboratory.

The WTW multi-340i/multiparameter set's probe (WTW Büro-Weilheim, Germany) was used to analyze in situ parameters. The chemical oxygen demand (COD) content was measured using the dichromate open reflux method (APHA et al., 2005). The filtering method was used to quantify the suspended solids concentration (TSS); the indophenol technique was used to measure NH_4^+ concentration; the diazotization technique was used to determine the concentration of NO_2^- ; regarding NO3-, this parameter was reduced to NO_2^- after passing via a cadmium-copper column (Rodier, 2009). Kjeldahl mineralization, ammonium distillation, and an acidimetric titration were used to estimate total Kjeldahl Nitrogen (TKN). The sum of NO_2^- , NO_3^- , and TKN was used to compute total Nitrogen (TN). Potassium peroxodisulfate digestion was used to determine total P (TP) (AFNOR, 1997). The technique described by APHA (1992) was used to evaluate exchangeable anions (Cl, CO₃, and HCO₃). An inductive coupled plasma method (ICP-AES) was used to assess the levels of exchangeable Na^+ , K⁺, Ca^{2+} , Mg^{2+} , heavy metals (Co, Ni, Pb, As, Cr, Be, and Al), and micronutrients (Fe, Zn, Mn, and Cu).

The Na%, SAR, and RSC were determined as follows:

Eq. (A.1): $Na\% = [(Na^+ + K^+)/(Ca^{2+} + Mg^{2+} + Na^+ + K^+)] \times 100$

Eq. (A.2): $SAR = Na^+ / \sqrt{(Ca^{2+} + Mg^{2+})/2}$

Eq. (A.3): $RSC = (HCO3^{-} + CO3^{2-}) - (Ca^{2+} + Mg^{2+})$

Fecal coliforms, total coliforms, and fecal streptococci were determined using a spread plate method and selective media including Lactose 2,3,5 Triphenyl Tetrazolium Chloride (TTC) (Panreac, Spain), Tergitol agar (Himedia, India), and Bile Aesculin Agar (Biokar Diagnostics, France). The dilution process was employed for RWW, and the filtering method employing a membrane (0.45 μ m) was applied for TWW and WW (Moroccan Standards, 2006). The number of bacterial indicators was measured in colony-forming units (CFU) per 100 milliliters (log CFU/100 ml) (Moroccan Standard 03.7.001, 2006).

2.3. Soil sampling and analyses

Twelve discrete soil samples were taken from each plot (three per line). Composite soil samples were made as bulk aliquots (200 g) from the previously homogenized twelve discrete soil samples taken from each plot. Soil samples were collected at 30 cm depth (Rocco et al., 2016). Soil sampling was done before the irrigation experiment began (T0) and then after the irrigation took place by the three different water qualities (RWW, TWW, and WW). The soil collection took place in the study area by gathering the different samples in plastic bags before analysis.



After combining certain grams of soil with distilled water (1:2 w/v soil water for pH and 1:5 w/v soil water suspensions for the EC), a multi-parameter probe (HI 9829, Hana; Romania) was used to measure the potential of hydrogen (pH) and electrical conductivity (EC). The Kjeldahl technique was used to investigate total N (Bremner, 1996). According to Nelson and Sommers (1982), the Smith-Weldon method was used to analyze soil organic matter. P (P) was analyzed with the OLSEN extraction using 0.5 M of NaHCO₃ (Olsen et al., 1954).

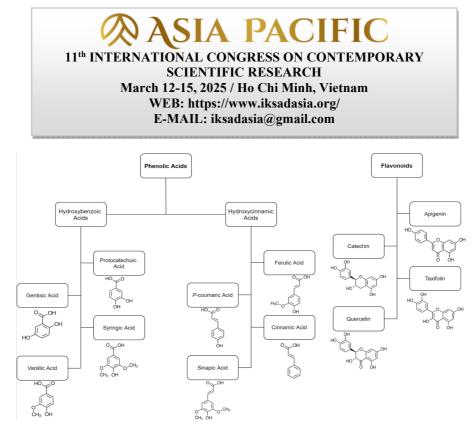
The concentration of Macro and micro-elements (Ca, Na, K, Mg, Mn, Zn, Fe, and Cu) was analyzed using an inductive coupled plasma mass spectroscopy (ICP-AES).

2.4. Plant sampling and analytical methods

When the crops reached maturity, a total of eight plants were randomly selected from each field per treatment (RWW, TWW, and WW). From each chosen plant, leaves at level four, measured from the plant's height, were collected in a random manner. They were subsequently measured in the laboratory. Growth parameters such as root, aerial, and grain dry weights were measured when the crops reached maturity. The maximum leaf area is calculated by the product of the maximum length and width (L_{max} and l_{max}), influenced by the coefficient 0.75 (Ruget et al., 1996). The plants underwent 48 hours of 70°C drying before being weighed to determine their dry weight. The amount of total chlorophyll in the plant leaves was settled using acetone in tubes, followed by sedimentation for 48 hours. A spectrophotometer was used to measure chlorophyll a, b, and c at three different wavelengths (470, 644, and 662 nm) (Upadhyaya & Panda, 2004). Ethanol and liquid N were used for the plant's extraction determined for the examination of total proteins and sugar, followed by centrifugation for 20 minutes and then left at -20° until analysis by Bradford reactor for the proteins (Bradford, 1976), phenol, and H_2SO_4 for the total soluble sugars (DuBois et al., 1956). For the plant grain, the total P was determined by the OLSEN extraction. The ash was melted in chloride acid after being converted to ash by around 0.5 g of plant grain in a furnace for 6 hours at 500°C. Using the molybdate blue technique, a calorimetric determination of the P concentration was made (Murphy & Riley, 1962). After color development at 100 °C for 10 minutes, the P concentration was determined by reading the absorbance at 820 nm. The Kjeldahl technique was used to quantify the concentration of N (Bremner, 1996). The P content was determined by observing the absorbance at 820 nm following 10 minutes of color development at 100 °C. Using the Kjeldahl technique, the concentration of N was determined (Bremner, 1996). Macro/Micronutrients (Ca, K, Mg, Na, Mn, Fe, Zn, and Cu) and heavy metals were determined by the Inductive Coupled Plasma Analyzer (ICP-AES). The ash was melted in chloride acid after being converted to ash by using 0.5 g of plant grain in a furnace for 6 hours at 500 °C. Using the molybdate blue method, a calorimetric analysis of the P concentration was made (Murphy and Riley, 1962). After color development at 100°C for 10 minutes, the absorbance at 820 nm was read to determine the P content. N (N) concentration was measured using the Kjeldahl method (Bremner, 1996). Macro/micronutrients (Ca, K, Mg, Na, Mn, Fe, Zn, and Cu) and heavy metals were identified using an inductive coupled plasma analyzer (ICP-AES).

2.5. phenolic compounds in millet.

polyphones, including aldehydes phenolic alcohols which continents Hydroxytyrosol,Tyrosol,Phenol and phenolic acids, as well as flavonoid compounds, which contribute to their chemical complexity and environmental impact.



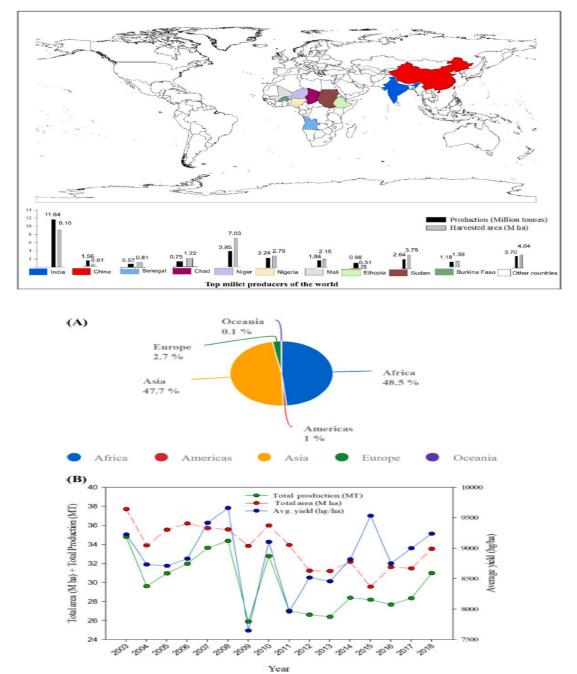
2.6. .Caracteristics of millet

Millet	Scientific Name	Color	Shape	Size	Origin	Kernels	Pictures of millet plant
Foxtail millet	Setaria italica	Pale yellow to orange	Ovoid	2 mm long	China	0	
Finger millet	Eleusine coracana	Light brown to dark brown.	Spherical	1–2 mm in diameter	East Central Africa (Uganda)		SX.
Pearl millet	Pennisetum glaucum	White, grey, pale yellow, brown, or purple.	Ovoid	3-4 mm in length	Tropical West Africa (Sahel)	S	
Proso millet	Panicum miliaceum	White cream, yellow, orange	Spherical to oval	3 mm long and 2 mm in diameter	Central and eastern Asia	1	
Kodo millet	Paspalum scrobiculatum	Blackish brown to dark brown	Elliptical to oval	1.2 to 9.5 µm long	Mainly in India also in west Africa	0	
Barnyard millet	Echinochloa crusgalli	White	Tiny round	2–3 mm long	Mainly in Japan and India	Ŏ	
Little millet	Panicum sumatrense	Grey to straw white	Elliptical to oval	1.8 to 1.9 mm long	Southeast Asia		

Picture source: Google and Baidu website.



2.7.Top millet producers of the World



(A) production share of millet by regions . (B) production/yield quantities of millet in the world 2003- 2023



2.8. Top millet producers of the world



3. RESULTS AND DISCUSSION

3.1. Suitability of Water for irrigation

3.1.1. Physicochemical analysis

The investigation of the new Trickling Filter (TF) technology in a Moroccan urban community unit confirmed the efficiency of this technology to remove organic matter, nutrients, and fecal contamination from domestic wastewater under an HLR between 160 and 250 L m⁻² day⁻¹. resulted in significant organic matter removal as well as a significant reduction (p < 0.05) in N and P, with an abatement of 97%, 79%, 76%, and 27%, respectively, for TSS, COD, TP, and TN. For fecal bacteria indicators, the TF system achieved high log removals, reaching 2.88 log units during two years of monitoring (Zidan et al., 2022). The performance of the TF system was good, and no clogging problem was detected during the monitoring period. The TF system has the capacity to disinfect domestic wastewater due to the implication of different mechanisms, including filtration, precipitation, and biodegradation (Zidan et al., 2023). For example, the major part of organic matter was reduced by biological degradation, especially in the upper parts where oxygenated conditions were more developed, causing a proliferation of microorganisms and the overgrowth of biofilms in the soil-based layer (SBL) (Sato et al., 2011). The performance of the TF technology was very high due to the adsorption and precipitation of P through the addition of iron metal to SBL (Zhang et al., 2020). The presence of nitrification and denitrification processes has a significant impact on TN removal inside the TF system. Finally, the removal of coliforms in the TF system is carried out by physical filtration, adsorption, and other processes, including predation and microbial cell death (die-off) (Song 2020; Sbahi et al. 2022).

Table 1 presents the physicochemical characteristics of three different water qualities used in the experimental study. The pH values of the three types of water were within the WHO limits of 6.5–8.5 (WHO, 2012). The (EC) and total dissolved solids (TDS) were higher in the RWW and WW than TWW. The greater values of these two parameters could be a result of the geological composition of the soil found in the groundwater of the study area.

Additionally, the EC values of three different water qualities were within the permissible limits of Morocco's irrigation standards.



The total hardness is due to the concentration of magnesium and calcium in the different waters (Dudziak et al. 2019). The total hardness of treated water equals the hardness of hard water (350–550 mg CaCO₃/L). Regarding Na, K, Ca, and Mg, which are crucial elements for plant production and better soil fertility, the results showed high concentrations in WW compared to RWW and TWW.

The WW exhibited higher average concentrations of CaCO₃, Na, Ca, Mg, Cl, HCO₃, and TDS compared to both the RWW and TWW. Additionally, the levels of Cl and HCO₃ surpassed the limits set by Morocco's irrigation standards. In the continental zone, particularly in the Marrakech region, the natural salinization of groundwater by aquifer rocks (Hssaisoune et al., 2020) and anthropogenic contamination from agricultural activities (El Mokhtar et al., 2012) contribute to this phenomenon. Such characteristics make it difficult to consider this well water as a reference of good water quality to compare with.

The most important water indicators to measure water quality are organic matter, total P, and N. COD, TSS, TP, NH_4^+ , and NO_3^- were not detected in WW. The quality of the treated water conformed to Morocco's irrigation standard limits. The concentration of chlorides was higher in WW, and a significant difference was found between the three water qualities. The concentration of chlorides in TWW and RWW was below the permissible limits of Morocco's irrigation standards.

					The admissible
					limit for wastewater
Parameters	Unit	RWW	TWW	ww	reuse
pH		8.11 ± 0.33^{a}	7.70 ± 0.37^{a}	8.60 ± 0.1^{a}	6.5 -8.4
EC (20°C)	dS/m	1.109 ± 0.003^{a}	1.006 ± 0.002^{b}	1.65±0.003°	12
TDS	mg/l	980±3.55ª	672±3.87 ^b	1020±4.98ª	7680
CaCO ₃	mg/l	468±2.1ª	477±1.1ª	706±2 ^b	
COD	mg/L	130.69 ± 42.77^{a}	27.74 ± 13.70 ^b	Not detected	-
TSS	mg/L	56.58± 37.97ª	1.54 ± 1.75 ^b	Not detected	2
$\rm NH_4^+$	mg/L	18.19 ± 3.75^{a}	3.05 ± 2.17 ^b	$0.1 \pm 0.02^{\circ}$	
NO3 ⁻	mg/L	1.92 ± 1.09^{a}	14.23 ± 5.69 ^b	$0.02 \pm 0.001^{\circ}$	30
ТР	mg/L	2.31 ± 0.95ª	0.55 ± 0.46^{b}	$0.10 \pm 0.02^{\circ}$	
Na	meq/L	4.74 ± 0.03^{a}	4.87 ± 0.038^{a}	11.57 ± 0.04^{b}	
Ca	meg/L	6.98 ± 0.05^{a}	6.49 ± 0.036^{a}	9.58 ± 0.02^{b}	
K	meq/L	0.82 ± 0.041^{a}	0.72 ± 0.031 ^b	0.23 ± 0.024°	
Mg	meq/L	$2.96 \pm 0.037a$	$2.97 \pm 0.04a$	$4.28 \pm 0.03c$	
<u>C1</u>	mg/l	57±1.2ª	162±3.2 ^b	863±2.1°	350

Table 1: Physicochemical characteristics of the three water treatments (RWW: rawwastewater; TWW: treated wastewater; WW: WW) used for millet irrigation (mean \pm standard deviation)



3.1.2. Sodium absorption ratio (SAR)

SAR is defined as a monitoring indicator to determine water quality for the irrigation of crops and to calculate the sodium hazard linked with the application of irrigation water for determining the sodium hazard associated with an irrigation water application (Alam et al. 2012). In addition, if the SAR value is less than 6, the water is suitable for irrigation. However, if the SAR is higher than 6, the water can produce sodium accumulation in the soil, which could negatively impact soil infiltration and cause soil crusting (Lesch & Suarez, 2009). Table 2 showed that values of SAR were between 2.12 and 4.39 meq/L. The three types of water were within permissible limits for irrigation, and soil sodification risk is considered slight to moderate.

3.1.3. Sodium percentage (Na %)

The proportion of sodium was determined using the Doneen method. The results of the sodium percentage of the water samples are categorized into three categories: good (20-40 Na%), acceptable (40-60 Na%), and doubtful (60-80 Na%) (Doneen, 1975). The sodium percentages of all treatments were in the permissible range (40-60 Na%) (Table 2).

3.1.4. Residual sodium carbonate (RSC)

Other parameters are most important for evaluating the irrigation suitability of water, such as the residual sodium carbonate (RSC), which helps identify the negative effects of carbonate (CO_3^{2-}) and bicarbonate (HCO₃) on the availability of water used for agricultural purposes (Raju, 2007).

The precipitation of magnesium and calcium ions is influenced by the high content of CO_3^{-2} and HCO_3^{-1} ions. When the content of Ca^{2+} and Mg^{2+} ions is higher than the content of CO_3^{-2} and HCO_3^{-1} ions in wastewater, the effluent is acceptable for irrigation.

According to Table 2, the RSC values are less than zero, which indicates that the three water qualities are safe for irrigation practices and that there is a possibility that Ca^{2+} and Mg^{2+} ions did not completely precipitate as carbonates.

	Unit	RWW	TWW	WW
SAR	meq/L	$2.10{\pm}0.02^{a}$	2.20±0.03 ^b	4.36±0.02°
Na% (SSP)	meq/L	42%±1% ^a	42%±2% ^a	53%±1% ^b
RSC	meq/L	-9.5±0.1 ^a	-5.5±0.2 ^b	-11.1±0.1°

Table 1. SAR, Na%, and RSC values at the three irrigations' water quality

3.2.Effect of irrigation water quality on millet crop

3.2.1. Growth parameters

Figure 2 presents the biomass production (roots, aerial, and grain dry weight) and leaf area of millet plants under different irrigation treatments: RWW, TWW, and WW during the experimental study. Notably, there was a significant increase (p < 0.001) in millet biomass when irrigated with RWW, followed by the TWW plots. The leaf area also showed a similar trend, reaching approximately 162.48 ± 7.67 cm² when irrigated with RWW. In contrast, the leaf area was lower, not exceeding 152.26 ± 2.45 cm² and 147.31 ± 4.31 cm² when irrigated with TWW and WW, respectively. The influence of wastewater irrigation on plant productivity varied depending on the chemical composition of the irrigation water. The contrasting nutrient content among the different water sources can account for the observed differences in productivity and growth. The results highlight that the higher nutrient content in RWW, acting as a fertilizer source, contributed to an increase in plant productivity.



Consistent with prior research, our findings demonstrate the positive impact of utilizing domestic wastewater on biomass production compared to crop cultivation with well water. This aligns with the observations made by Rusan et al. (2007), who noted that barley irrigated with wastewater exhibited taller biomass compared to barley irrigated with well water. The increase in biomass was attributed to the nutrient content in the wastewater. Similarly, Abegunrin et al. (2013) reported enhanced growth traits in cucumber irrigated with kitchen wastewater compared to groundwater. Mojiri et al. (2013) also found that irrigation with wastewater significantly increased root length and shoot length in *Lepidium sativum* compared to plants irrigated with fresh water. These improvements in biomass can be attributed to various factors, such as changes in cell wall extensibility associated with protein composition (Hasegawa et al., 1984), reduction in photosynthetic capacity (Erice et al., 2011), and alterations in hormonal metabolism (Wilkinson and Davies, 2002). *Millet* exhibited better adaptation to the quality of treated wastewater, as it benefited from the nutrients present, particularly nitrogen and phosphorus. These nutrients significantly contribute to plant growth compared to the relatively limited growth associated with well water.

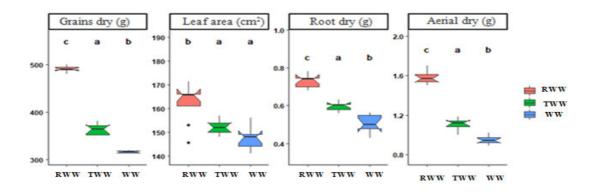


Fig. 2. The biomass production (roots, aerial parts, and grain dry) and leaf area of millet plants, irrigated by the three water treatments (RWW: raw wastewater; TWW: treated wastewater; WW: WW). The three letters (a, b, and c) represent a significant difference by notched boxplot test.

3.2.2.Macro and micronutrient parameters

Water quality was not found to be detrimental to plant health, taking into account macroelements (N, P, K, Ca, Mg, and Na), which are considered necessary for the health of *millet* (N, P, K, Ca, Mg, and Na), as reported by Orhue (2005) and Rezapour et al. (2021). Domestic wastewater application significantly affected the content of macro-elements (N, P, K, Ca, Mg, and Na) in *millet* (Fig. 3). Plants irrigated with RWW produced the highest amounts of N with $6.7 \pm 0.91\%$, P with $6.2\pm1.1\%$, and K with $2.05\pm0.5\%$. However, the plants irrigated with WW had a high content of Ca with $0.3\pm0.8\%$, Na with $0.4\pm0.95\%$, and Mg with $0.1\pm0.82\%$. Furthermore, compared to RWW and WW, the TWW yielded a medium concentration of N ($4.3\pm0.45\%$), P ($5.62\pm1.2\%$, and K ($1.85\pm0.15\%$, Ca ($0.17\pm0.68\%$), Mg ($0.5\pm0.87\%$), and Na ($1\pm0.96\%$). This was the direct consequence of the important amount of nutrients provided by irrigation with RW, TWW by the Trickling filter system.



Based on these results, it can be concluded that water irrigation significantly affects millet yield and mineral content. The enhancement of plant macronutrient content with domestic wastewater irrigation indicates that wastewater irrigation supplied the soil with these nutrients, which improved plant growth and soil fertility (Orhue et al., 2005). Indeed, plant growth and nutrient content can be enhanced by properly managed irrigation with preserved nutrients in treated wastewater (Alawsy et al., 2018). Consequently, TWW-irrigated plants showed medium levels of biomass production and nutrient content compared to those irrigated with RWW and WW. As we discussed previously, these treated wastewaters by TF system, in addition to the significant load of nutrients, meet standards for wastewater reuse in agriculture (Blumenthal et al. 2000; Moroccan standards 2007). The micronutrient contents (Fe, Zn, Mn, and Cu) of Zea mays treated by water of the three different qualities are shown in Fig. 4. These micronutrients are necessary for plant nutrition only if they are required by the crops in much lower quantities compared to macronutrients (Elfanssi et al., 2018). The metrics indicate that *millet* uptake a lower and similar content of micronutrients than RWW, TWW, and WW. These results were in line with prior research investigating the effect of short-term irrigation on micronutrient accumulation in plants (Adrover et al., 2012; Kiziloglu et al., 2008; Mapanda et al., 2005; Younas et al., 2022). Additionally, the accumulation of micronutrients might be affected directly by irrigation water quality or indirectly by an increase in the solubility of the native, insoluble soil micronutrient (El Moussaoui et al., 2019; Lucho-Constantino et al., 2005; Mapanda et al., 2005; Yu et al., 2007).

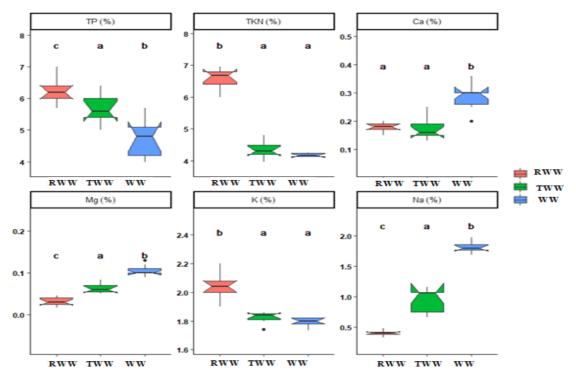


Fig. 3. The macronutrient contents of plant grain, irrigated by the three water treatments (RWW: raw wastewater; TWW: treated wastewater; WW: WW)

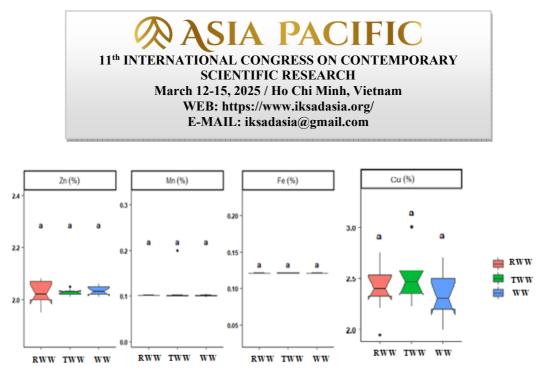


Fig. 4. The micronutrient contents (Fe, Mn, Cu, and Zn) of plant grain, irrigated by the three water treatments (RWW: raw wastewater; TWW: treated wastewater; WW: WW)

3.2.3. Total Chlorophyll

Figure 5 illustrates the impact of the three water qualities on the total chlorophyll content of *millet* crops. The application of WW and TWW resulted in significantly higher chlorophyll content. The obtained results confirmed that even after irrigation with WW and TWW, the chlorophyll concentration in the plants remained higher. This indicates a greater potential for capturing light energy and enhancing photosynthetic activity. Additionally, TWW did not demonstrate any discernible effect on the photosynthetic activity of the plants under investigation. These findings align with the research conducted by Jóźwiakowski et al. (2020), who reported that potassium (K) deficiency had the most significant inhibitory impact on photosynthesis in millet plants. Conversely, the study did not observe any notable influence of phosphorus (P) content on overall chlorophyll levels during a short-term deviation from optimal macronutrient levels. Previous studies have utilized chlorophyll content to explain phenomena such as heavy metal stress (Mallick & Mohn, 2003), nutritional deficiencies in raw domestic wastewater (Elfanssi et al., 2018), and reclaimed wastewater (Bañón et al., 2011). Conversely, Ahmali et al. (2020) found that irrigation water with high salinity can induce photosynthetic stress in plants, with total chlorophyll serving as an indicator of this stress.

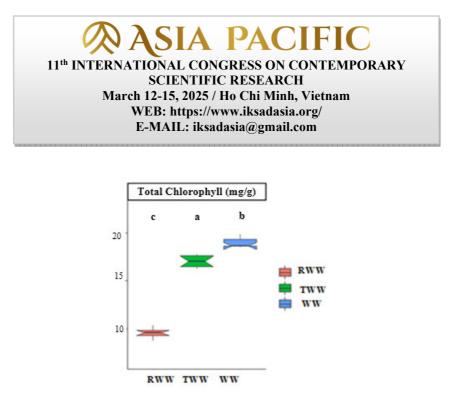


Figure 5. Total chlorophyll leaves contents of the corn irrigated by the three water treatments (RWW: raw wastewater; TWW: treated wastewater; Well water: WW).

3.3.Biochemical parameters

3.3.1. Sugar

Figure 6A shows the concentrations of sugars determined in *millet* leaves obtained under irrigation with WW, RWW, and TWWs. However, significant variations (P < 0.05) were observed among treatments. millet crops grown under irrigation with RWW and TWW showed comparable concentrations of total sugars. Indeed, miullet irrigated with WW showed significantly lower values of total sugar compared to those irrigated with RWW and TWW. The lower abundance of sugars in *millet* leaves might be ascribable to the salinity of the WW used for irrigation, which showed a Cl concentration exceeding the Moroccan legal limits for water reuse (Table 1). The high concentrations of chloride (Cl) present in the irrigation water could have resulted in a water deficit within the maize plants. This salt stress can have detrimental effects on plant growth, including a reduction in relative water potential, as observed in previous studies (El Sabagh et al., 2020). Additionally, the negative impacts of salt stress can extend to the quality of both soil and water, both in the short and long term, as highlighted by research conducted by Seleiman et al. (2021).

3.3.2. Protein

Figure 6B illustrates the impact of irrigation water quality on the protein content of maize leaves. It was observed that plants irrigated with raw wastewater (RWW) exhibited higher protein accumulation, reaching 22.01 ± 2.53 mg/g. In contrast, the protein content in leaves irrigated with TWW and WW did not exceed 13.23 ± 1.33 mg/g and 12.90 ± 2.03 mg/g, respectively. This disparity suggests that while RWW induced physiological stress, TWW and WW did not adversely affect the physiological state of millet , as supported by findings from Newson et al. (2015).

Similar observations have been reported by Suke et al. (2011), who found that millet protein content increased with higher levels of NPK and biofertilizers. Rija et al. (2005) also reported comparable outcomes in their study on the impact of sewage irrigation on crops such as *Cicer arietinum*, *Lens culinaris*, and *Vigna radiata*. They attributed the rise in total protein and carbohydrate levels in leaf samples from *C. arietinum* and *L. culinaris* to the activities of various microorganisms present in sewage water, which convert organic matter into by-products such as CO₂, NH₃, H₂S, NO₃, PO₄, SO₄, and CH₄.



Furthermore, Latef and Ahmad (2015) proposed that the higher concentrations of macronutrients in wastewater serve as cofactors for the enzymes involved in protein production in millet plants.

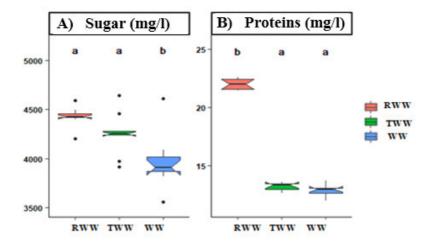


Figure 6. Sugar (A), and Proteins (B) leaves contents of crops, irrigated by the three water treatments (RWW: raw wastewater; TWW: treated wastewater; Well water: WW).

Conclusions

In arid regions, treated wastewater is a valuable resource for irrigation as it provides water and some nutrients (N, P, and K) to crops. The present study reveals significant variations in the physicochemical and microbial characteristics of water and soil, as well as the physiological responses of millet crops, among the three types of irrigation waters investigated (WW, RWW, and TWW). The quality of TWW, treated using the Trickling Filter (TF) technology, has successfully met the permissible limits for reuse in irrigation without posing any health risks according to Moroccan standards. However, WW exhibits high salinity, with chloride concentrations surpassing the legal limits for water reuse in Morocco. Moreover, the values of RSC, SAR, and Na% indicate that all treatments are suitable for

Moreover, the values of RSC, SAR, and Na% indicate that all treatments are suitable for irrigation. However, soil analyses reveal that soils irrigated with RWW contain elevated levels of physicochemical parameters such as COT, NTK, and TP, which can be detrimental to plants when they exceed specific thresholds. Despite the fact that RWW has a high nutritional value that can promote plant growth, albeit with noticeable variations compared to TWW using the TF eco-technology, irrigation with RWW leads to a decrease in overall chlorophyll content in millet , but stimulates the significant accumulation of parameters such as total soluble protein and sugars. In contrast, TWW demonstrates important nutritive value that has the potential to enhance plant growth, reduce the need for fertilizer application (including the cost of mineral fertilization), and increase the productivity of infertile soils. However, WW results in a lower abundance of sugars in *millet* leaves, which might be attributed to the salinity of the WW used for irrigation, there by questioning its use as a reference.

In conclusion, among the investigated irrigation water sources, TWW produced through the *TF process could be considered the most suitable option for water reuse in agriculture and* can serve as a valuable source of plant nutrients and soil fertilizers.



TWW possesses significant nutritive value that can enhance plant growth, reduce the need for fertilizer application and associated costs, and ultimately improve the productivity of infertile soils. Nonetheless, further research is necessary to evaluate the long-term effects of TWW irrigation on soil and crops.

Balanced dietary requirements are increasing with the growing population. Millets are a rich source of all nutrients and phytochemicals which combat chronic diseases. Due to their nutrient-rich profile, millets could be the best option as potential cereal grain for human consump- tion. This review summarizes the advanced research studies from 2013 to 2020 on millet consumption, health benefits, and nutritional changes under different processing methods. The need for the hour is to enhance nutrient bioavailability and reduce anti-nutrients, which is necessary for better utilization and manufacturing of new functional food products. Frequent consumption of millets-based products in daily life could help to maintain a healthy lifestyle as it is a cheap and readily available food source. Besides, valorizing millet products at the industrial level pro- vides accessibility of affordable and nutritious food to a poor man and an opportunity for farmers to increase their income. However, there is still a need to focus on millet consumption's effectiveness as a staple food to improve nutritional security in the future.

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NUTRITIONAL APPLICATIONS OF MILLET GRAINS FOR FOOD AND FEED PRODUCTION: IRRIGATION WITH TRICKLING FILTER-TREATED WASTEWATER IN SEMI-ARID CLIMATES

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Abstract

Worldwide, millets are regarded as a significant grain, however, they are the least exploited. Millet grain is abundant in nutrients and health-beneficial phenolic compounds, making it suitable as food and feed. The diverse content of nutrients and phenolic compounds present in finger and pearl millet are good indicators that the variety of millet available is important when selecting it for use as food or feed. The phenolic properties found in millets compromise phenolic acids, flavonoids, and tannins, which are beneficial to human health. Moreover, finger millet has an excep- tionally unique, more abundant, and diverse phenolic profile compared to pearl millet. Research has shown that millet phenolic properties have high antioxidant activity. The presence of phytochemicals in millet grains has positive effect on human health by lowering the cholesterol and phytates in the body. The frantic demands on maize and its uses in multiple industries have merited the search for alternative grains, to ease the pressure. Substitution of maize with pearl and finger millets in the diets of different animals resulted in positive impact on the performance. Including these grains in the diet may improve health and decrease the risks of diseases. Pearl millet of 50% or more can be used in broiler diets without adversely affecting broiler performance or egg production. Of late, millet grain has been incorporated in other foods and used to make traditional beverages. Thus, the core aim of this review is to provide insight and comprehension about the nutritional and phenolic status of millets and their impact on human and livestock. An experimental reuse study was performed using raw (RWW) and treated urban wastewater (TWW) by Trickling Filter (TF) process to irrigate Millet in comparison to well water (WW) as a control over a period of 5 months. In this study, we also assessed the agrophysiological and biochemical proprieties of the crops. Hence, the highest productivity of millet and leaf area were obtained in response to irrigation with RWW and TWW compared to WW; while macro-elements (TP, TKN, and K) were also affected in millet irrigated with RWW compared to TWW and WW.



However, the plants irrigated with well water accumulate more Ca, Na, and Mg than those irrigated with RWW and TWW. Moreover, the use of treated urban wastewater improves the physicochemical properties and fertility of the soil compared to well water and enhances crop productivity.

Keywords: Millet; irrigation; treated wastewater reuse; physiological proprieties; Trickling Filter.

1. Introduction

Millets are cereals from the Poaceae grass family and are considered one of the oldest cultivated crops. Generally, pearl millet (Pennisetum glaucum) and finger millet (Eleusine coracana) are known as the two major millets used for food and feed. Pearl millet is believed to have originated from north Africa, and finger millet from the subhumid uplands of East Africa [1]. The two account for most of the world's millet production and trade [2]. The majority of the recent research and agricultural programmes, which are routed towards the development of millets, have been dedicated to pearl and finger millets. Dube et al. [3] believe that the urge to route for millet and sorghum instead of maize and other major crops in recent years is derived from the fact that these grains are ecologically well-matched with semi-arid areas because of their ability to tolerate drought. They are considered tough crops in terms of growth requirements as they withstand harsh climatic factors such as unpredictable climate and nutrient depleted soils [4].

Globally, pearl millet is an important grain and is considered the sixth highest producing crop, after maize, wheat, rice, barley, and sorghum [5]. It is also considered one of the crops that can provide good nutrition and income to small scale farmers [6] and thus, contributes to livelihoods and the availability of food. Despite its value and contribution, pearl millet does not receive the attention it deserves as a crop that has an important role to play in food security. Perhaps the disregard can be attributed to it being termed a crop for poor farmers in marginal agricultural areas affected by socio-ecological conditions [1]. According to several researchers, millets can be an important source of essential nutrients such as amino acids, and mineral and trace elements [7]. Obviously, wide variations should be evident in the nutritional composition of pearl and finger millets [2]. Shweta, [8] reported that pearl millet contains higher energy compared to cereal grains such as rice and wheat, and is considered a significant source of thiamine, niacin, and riboflavin as stated by [9]. Moreover, the content of minerals such as calcium, iron and phosphorus in pearl millet is like those found in other cereals [10].

In addition, finger millet grows better in colder areas that have slightly more rain [11]. In many rural communities in East and north Africa (morocco) imintanoute Marrakeck, finger millet is known as an important cereal as it contributes significantly to nutritional well being. In spite of its valued role and its vital contribution to food availability of many underprivileged farmers and families in Africa, it is also a crop that is overlooked [12]. The protein found in finger millet is considered as superior as it encompasses vital amino acids such as lysine, threonine, and valine [13].

Millets are also believed to have nutraceutical health benefits. These include but are not limited to, an increase in digestive system well being, a reduction in cholesterol, the prevention of heart disease, protection against diabetes, the lowering of cancer risks, and an increase in energy levels and improvement of the muscular system [14, 15].

These characteristics ought to place such grains in the right position in terms of alternative crops; however, due to a lack of attention, millet was termed the 'lost crop' [2].



Given the current challenges regarding sustainable food production, climatic changes, and water scarcity, coupled with overpopulation, an interest has been developed regarding millet. This has provided an opportunity for farmers, nutritionists, and food and feed manufacturers to engage in research in order to understand the nutritional and functional characterisation of millet grains. Although reviews in this area have been published

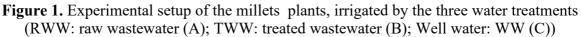
recently [16], this recherche is comprehensive and provides important updates on the utilisation of pearl and finger millets in diets for humans and animals. Specifically, this recherche (1) provides detailed nutritional composition and its benefits to humans and livestock; (2) it summarises the phenolic properties found in pearl and finger millet grains, as well as their contributions to health or as anti- nutritive factors in animal feeding, and (3) it discusses millets in feed and food applications. Thus, the overview and core objective of this review is to provide insights into the selection of millets for different purpose to maximise their potential as food and feed.

2.Material and Methods

2.1.Experimental set-up

The effect of processed wastewater on soil properties and the agro-physiological properties of millet was investigated under arid conditions in three separate pot experiments. Millet(pearl and finger) is a monoecious annual herbaceous plant from the grass family. It comes from North America. It is a leguminous plant, with good nutritional quality, and high protein content, is more cultivated in the world, and also benefits soil fertility (Harbouze et al., 2019). The experiment site is Imintanoute (Marrakech, Morocco). This region has an arid climate, with an average annual rainfall of 240 mm. Urban wastewater was treated with TF plant, which has been implemented at the university since 2016 (Zidan et al., 2022; 2023). A test field is established across from the TF hybrid and is designated for the cultivation of three plots (P1, P2, and P3), each measuring (3.65 m × 2.5 m) and separated by a 3m alley, each plot divided into four lines with 10 replications (Figure 1). In total, three types of irrigation water were used to irrigate 120 corn trees: RWW, TWW, and WW. Irrigation was applied twice weekly to keep moisture content levels in the three plots under study at 60% of field capacity, as suggested for arid regions with high temperatures based on prior studies (Nasta et al., 2023). This reduced saturation level, which is controlled by air temperature, has been found to boost millet growth, according to Xiong et al. (2020). The experiment was carried out in 2019, from March through July, which is a hot season of the year in Marrakech. The irrigation technique employed was drip irrigation, and each irrigation treatment required 93 liters of water per plot.







2.2.Water sampling and analyses

Water samples were collected from the inlet and outlet of the wastewater treatment by trickling filter (TF) which represent, respectively, RWW and TWW. For WW, it was taken from the tap connected with the well water. The depth of the well exceeds 55 m, and it is protected from all the activities nearby. Ten samples were taken from each irrigation water source from March to July. They were stored in sterile glass bottles for physicochemical analysis. The bottles were transported in a cooler at a temperature of 4 °C to the analysis laboratory.

The WTW multi-340i/multiparameter set's probe (WTW Büro-Weilheim, Germany) was used to analyze in situ parameters. The chemical oxygen demand (COD) content was measured using the dichromate open reflux method (APHA et al., 2005). The filtering method was used to quantify the suspended solids concentration (TSS); the indophenol technique was used to measure NH4+ concentration; the diazotization technique was used to determine the concentration of NO2-; regarding NO3-, this parameter was reduced to NO2- after passing via a cadmium-copper column (Rodier, 2009). Kjeldahl mineralization, ammonium distillation, and an acidimetric titration were used to estimate total Kjeldahl Nitrogen (TKN). The sum of NO2-, NO3-, and TKN was used to compute total Nitrogen (TN). Potassium peroxodisulfate digestion was used to evaluate exchangeable anions (Cl, CO3, and HCO3). An inductive coupled plasma method (ICP-AES) was used to assess the levels of exchangeable Na+, K+, Ca2+, Mg2+, heavy metals (Co, Ni, Pb, As, Cr, Be, and Al), and micronutrients (Fe, Zn, Mn, and Cu)

2.3. Physical characteristics

Generally, the kernel structure of different millets is like that of sorghum. It consists of the pericarp, germ, and endosperm (Table 1; Fig. 1). Like with sorghum, the kernel of pearl millet is caryopsis, where the pericarp is entirely attached to the endosperm. However, in finger millets, sack like pericarps are loosely connected to the endosperm at one point. These types of kernels in finger millet are known to be utricle, whereby their pericarp can easily detach for the testa to shield the endosperm [17].

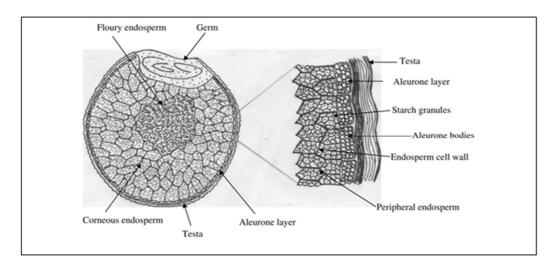
As indicated by Abdelrahman et al. [18], the relative distribution of the pearl millet is 8.4% of the pericarp, 75% of the endosperm and 16.5% of the germ [18]. Thus, the proportion of the pearl millet's endosperm to germ is about 4.5:1, and 8.4:1 in sorghum. The ratio is smaller in finger millet because of its small germ, namely, the endosperm to germ ratio is 11:1 to 12:1, which is more than sorghum and pearl millet [18]. As indicated in Table 1, variations exist between the visual colour of pearl and finger millets, with the 1000 kernel weight being very small for the finger millet [19]. An endosperm is regarded as the largest part of the cereal grain and it acts as a storage tissue [20]. In millets, "the aleurone layer is a single layer of cells which lies just below the testa" [18]. The texture of the millet kernel is controlled by the size of floury and corneous endosperm. More floury than corneous endosperm is found in soft-textured kernels however, solid kernels have more thickly filled corneous endosperm. Moreover, the endosperm of the finger millet is equally divided between the corneous and floury areas. These types of endosperm are known to have an in-between texture. In pearl millet, wide variations exist among the kernel textures as follows: floury, very soft, corneous, and very hard endosperm.



The embryo of finger millet is in a depression enclosed by a distinctive crest and the hilum is located adjacent to the germ [21]. Whilst the protein bodies are small spheres below the cell walls [21] (Fig. 2).

When it comes to the processing and food quality of millets, the texture of the grains is an important con- tributing factor to consider [22]. There are higher flour yields when dry milling corneous as opposed to soft floury kernel types. Cultivars with higher amounts of corneous endosperm are preferred when making thick porridge. In contrast, the flour produced from soft endosperm is greatly desired [22] when making either fermented or unfermented bread. With animal feding an intermediate texture is preferred over the corneous and floury texture as it increase the starch digestion.

Grain	Туре	Shape		Colour			1 kernel weight	000- (g)
Sorghum	Caryopsis	Spherical		White, y	vellow, red	l, brown	25-30	
Pearl millet	Caryopsis	Ovoid, globose	hexagonal,	Grey, brown, j	white, ourple	yellow,	2.5–14	
Finger millet	Utricle	Globose		Yellow, brown,	white	, red,	2.6	



3. Resultats and discussion

3.1.Suitability of Water for irrigation

3.1.1.Physicochemical analysis

The investigation of the new Trickling Filter TF technology in a Moroccan urban community unit confirmed the efficiency of this technology to remove organic matter, nutrients, and fecal contamination from domestic wastewater under an HLR between 160 and 250 L m-2 day-1. resulted in significant organic matter removal as well as a significant reduction (p < 0.05) in N and P, with an abatement of 97%, 79%, 76%, and 27%, respectively, for TSS, COD, TP, and TN. For fecal bacteria indicators, the FTsystem achieved high log removals, reaching 2.88 log units during two years of monitoring (Zidan et al., 2022). The performance of the TF system was good, and no clogging problem was detected during the monitoring period.



The TF system has the capacity to disinfect domestic wastewater due to the implication of different mechanisms, including filtration, precipitation, and biodegradation (Zidan et al., 2023). For example, the major part of organic matter was reduced by biological degradation, especially in the upper parts where oxygenated conditions were more developed, causing a proliferation of microorganisms and the overgrowth of biofilms in the soil-based layer (SBL) (Sato et al., 2011). The performance of the hybrid technology was very high due to the adsorption and precipitation of P through the addition of iron metal to SBL (Zhang et al., 2020). The presence of nitrification and denitrification processes has a significant impact on TN removal inside the TF system. Finally, the removal of coliforms in the TF system is carried out by physical filtration, adsorption, and other processes, including predation and microbial cell death (die-off) (Song 2020; Sbahi et al. 2022).

Table 1 presents the physicochemical characteristics of three different water qualities used in the experimental study. The pH values of the three types of water were within the WHO limits of 6.5–8.5 (WHO, 2012). The (EC) and total dissolved solids (TDS) were higher in the RWW and WW than TWW. The greater values of these two parameters could be a result of the geological composition of the soil found in the groundwater of the study area.

Additionally, the EC values of three different water qualities were within the permissible limits of Morocco's irrigation standards. The total hardness is due to the concentration of magnesium and calcium in the different waters (Dudziak et al. 2019). The total hardness of treated water equals the hardness of hard water (350–550 mg CaCO3/L). Regarding Na, K, Ca, and Mg, which are crucial elements for plant production and better soil fertility, the results showed high concentrations in WW compared to RWW and TWW.

The WW exhibited higher average concentrations of CaCO3, Na, Ca, Mg, Cl, HCO3, and TDS compared to both the RWW and TWW. Additionally, the levels of Cl and HCO3 surpassed the limits set by Morocco's irrigation standards. In the continental zone, particularly in the Marrakech region, the natural salinization of groundwater by aquifer rocks (Hssaisoune et al., 2020) and anthropogenic contamination from agricultural activities (El Mokhtar et al., 2012) contribute to this phenomenon. Such characteristics make it difficult to consider this well water as a reference of good water quality to compare with.

The most important water indicators to measure water quality are organic matter, total P, and N. COD, TSS, TP, NH4+, and NO3- were not detected in WW. The quality of the treated water conformed to Morocco's irrigation standard limits. The concentration of chlorides was higher in WW, and a significant difference was found between the three water qualities. The concentration of chlorides in TWW and RWW was below the permissible limits of Morocco's irrigation standards.

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Table 1: Physicochemical characteristics of the three water treatments (RWW: rawwastewater; TWW: treated wastewater; WW: WW) used for millet irrigation (mean \pm standard deviation)

Parameters	Unit	RWW	TWW	WW	The admissible limit for wastewater reuse
pH	Cint	8.11 ± 0.33^{a}	7.70 ± 0.37^{a}	8.60 ± 0.1^{a}	6.5 -8.4
EC (20°C)	dS/m	1.109 ± 0.003^{a}	1.006 ± 0.002^{b}	$1.65 \pm 0.003^{\circ}$	12
TDS	mg/l	980±3.55 ^a	672 ± 3.87^{b}	1020 ± 4.98^{a}	7680
CaCO ₃	mg/l	468±2.1ª	477±1.1 ^a	706±2 ^b	1000
COD	mg/L	130.69 ± 42.77^{a}	27.74 ± 13.70^{b}	Not detected	
TSS	mg/L	56.58 ± 37.97^{a}	1.54 ± 1.75^{b}	Not detected	2
NH4 ⁺	mg/L	$18.19\pm3.75^{\mathrm{a}}$	3.05 ± 2.17^{b}	$0.1 \pm 0.02^{\circ}$	
NO ₃	mg/L	1.92 ± 1.09^{a}	14.23 ± 5.69^{b}	$0.02 \pm 0.001^{\circ}$	30
ТР	mg/L	$2.31\pm0.95^{\text{a}}$	$0.55\pm0.46^{\text{b}}$	0.10 ± 0.02^{c}	
Na	meq/L	$4.74\pm0.03^{\rm a}$	4.87 ± 0.038^{a}	11.57 ± 0.04^{b}	
Са	meq/L	$6.98\pm0.05^{\rm a}$	6.49 ± 0.036^a	$9.58\pm0.02^{\mathrm{b}}$	
К	meq/L	0.82 ± 0.041^a	0.72 ± 0.031^{b}	$0.23 \pm 0.024^{\circ}$	
Mg	meq/L	$2.96 \pm 0.037a$	$2.97\pm0.04a$	$4.28\pm0.03c$	
Cl	mg/l	57±1.2 ^a	162±3.2 ^b	863±2.1°	350
CO3 ⁻	meq/L	$0.0\pm0^{\mathrm{a}}$	0.3±0.01ª	0.1±0.02 ^a	
HCO ₃ -	meq/L	0.24±0.01 ^a	3.25±0.01 ^b	2.4±0.03°	8.48 mg/l
Al	g/1	< 0.001	< 0.001	< 0.001	0.005
В	g/1	< 0.001	< 0.001	< 0.001	0.003
Be	g/1	< 0.001	< 0.001	< 0.001	0.0001
Cd	g/1	< 0.001	< 0.001	< 0.001	0.00001
Cr	g/1	< 0.001	< 0.001	< 0.001	0.001
Cu	g/1	0,001	< 0.001	0,002	0.002
Fe	g/1	0,001	< 0.001	0,001	0.005
Zn	g/1	< 0.001	< 0.001	< 0.001	0.002
Hg	g/1	< 0.001	< 0.001	< 0.001	10-6
Li	g/1	< 0.001	< 0.001	< 0.001	2.5*10 ⁻³
Mn	g/1	< 0.001	< 0.001	< 0.001	0.0002
Мо	g/1	< 0.001	< 0.001	< 0.001	0.00001
Ni	g/1	< 0.001	< 0.001	< 0.001	0.002
Pb	g/1	< 0.001	0.001	0,001	0.005
Total coliforms	Log.	6.50 ± 0.77	3.48 ± 0.48	Not detected	
Fecal coliforms	Log.	5.44 ± 0.5	2.56 ± 0.40	Not detected	3
Total streptococci	Log.	5.2 ± 0.57	2.36 ± 0.33	Not detected	

The different letters (a, b, and c) represent the significant difference according to the Tukey test at p < 0.05.



The concentrations of micronutrients (Fe, Mn, Cu, and Zn) and heavy metals (Al, Cd, Cr, Hg, Li, etc.) are noted in Table 1. The results showed that the average concentration of micronutrients and heavy metals was well within the standard limits for agricultural irrigation (Moroccan Standards, 2006).

The findings demonstrated that the average concentration of micronutrients and heavy metals was within the permissible limits for irrigation of agricultural land (Moroccan Standards, 2006).

The microbiological characteristics of the three treatments of irrigation water are presented in Table 1. The average content of fecal bacteria in treated water was $3.48 \pm 0.48\log/100$ ml, $2.56 \pm 0.40 \log/100$ ml and $2.36 \pm 0.33 \log/100$ ml for total coliform (TC), fecal coliform (FC), and fecal streptococci (FS), respectively.

The comparison between the three irrigation water qualities shows that RWW contains a high content of fecal bacteria, whereas WW was free from fecal contamination (not detected). However, TWW quality was below the norms suggested by Moroccan standards for irrigating crops that are destined for human consumption: 3 logs/100 ml for FC (Moroccan Standards, 2006).

3.1.2. Nutritional profile of millets

Nutritionally, the energy value, protein and macro nutrient contents of millets is comparable and sometimes higher than conventional cereals. They significantly contribute to human and animal diets owing to their high levels of energy, calcium, iron, zinc, lipids, and highquality proteins. In addition, they are also rich sources of dietary fibre and micronutrients

3.1.3.Carbohydrates

The carbohydrates in pearl millet grains incorporate starch, dietary fibre, and soluble sugars. Starch is considered a predominant component of pearl millet endosperm, which comprises glucose in the form of amylase and amylopectin. Various pearl millet grain genotypes vary in starch composition from 62.8 to 70.5% and around 71.82 to 81.02% as reported by [23], soluble sugars range from 1.2 to 2.6% and amylose from 21.9 to 28.8%. However, [24] recorded a low figure of 34.5 and

39.4 g/100 g of starch for pearl millet. The starch in pearl millet can be used as thickening, gelling and as bulking agents for the textural properties of foods [25]. Finger millet on the other hand has a total carbohydrate content that ranges between 72 and 79.5%, as recorded by [26]. Moreover, the detailed profile of the carbohydrates was recorded by [27] to be at a range of 59.5 and 61.2% for starch, 6.2–7.2% for pentosans, 1.4–1.8% for cellulose, and 0.04–0.6% for lignin.

3.1.4.Proteins

The second major component of millet is protein. Pear millet is believed to contain about 11.6% protein, which is higher than the 7.2% protein found in rice, 11.5% found in barley, 11.1% found in maize and 10.4% found in sorghum which is [28]. In addition, [7] recorded protein content of 9.79% found in pearl millet. In comparison to maize, by weight, pearl millet grain is believed to be about 8–60% higher in crude protein [29]. In contrast, finger millet contains about 5–8% protein [30], 31 recorded the highest protein content for finger millet of about 11%, while [7] recorded a percentage of 6.32% in finger millet. The quality of protein is believed to be a function of the essential amino acids available in protein (Tables 2, 3).



Furthermore, [10] reported that the amino acids pro- file of pearl millet has more lysine, threonine, methionine, and cysteine than sorghum and corn proteins, but is comparable to wheat, barley, and rice [32, 33]. Moreo- ver, pearl millet grain is considered to be similar to maize in terms of its distribution of proteins, particularly true prolamins, which are believed to be soluble in alcohol [34].

Nutrients	Pearl millet	Finger millet 7.15-13.1	
Moisture	12.4		
Protein	11.6-11.8	7.7	
Fat/lipids	4.8-5.0	1.8	
Minerals	2.2-2.3	2.7	
Dietary fibre	11.3	15-22.0	
Neutral detergent fibre	9.0	12.7	
Acid detergent fibre	3.3	8.7	
Carbohydrates	67-67.5	75.0-83.3	
Gross energy (MJ/kg)	17.0	15.8	
Minerals (mg/ 100 g)			
Phosphorus	296	130-250.0	
Potassium	307	430-490	
Magnesium	137	78-201	
Calcium	42	398.0	
Sodium	10.9	49.0	
Zinc	3.1	2.3	
Iron	8.0	3.3-14.89	
Manganese	1.15	17.61-48.43	
Copper	1.06	0.47	

Table 2 Proximate analysis of pearl and finger millets

Table 3 Amino acid profiles of different millet grain varieties (pearl and finger millet)

Amino acids (g/100 g)	Pearl millet	Finger mille	
Essential amino acid			
Isoleucine	5.1	4.3	
Leucine	14.1	10.8	
Lysine	0.5	2.2	
Methionine	1.0	2.9	
Phenylalanine	7.6	6.0	
Threonine	3.3	4.3	
Valine	4.2	6.3	
Histidine	1.7	2.3	
Tryptophan	1.2	NA	
Nonessential amino acid			
Alanine	8.1	6.1	
Arginine	0.9	3.4	
Aspartic acid	6.2	5.7	
Cystine	0.8	NA	
Glutamic acid	22.8	23.2	
Glycine	0.7	3.3	
Serine	5.4	5.3	
Tyrosine	2.7	3.6	
Proline	8.2	9.9	

Furthermore, [34] reported high level of essential amino acid balance and approves of pearl millet as an important source of energy and proteins for humans. In addition, when comparing the digestibility among the essential amino acids, the following were found to have higher digestibility in pearl millet than corn: arginine, threonine, valine, isoleucine, and leucine. Finger millet is comparatively balanced in its content of essential amino acids because it contains more lysine, threonine, and valine than other millet varieties [13].

3.1.5.Dietary fibre

Fibre is considered important for gut health as stated by [35] and moderate intake of high fibre in foods could result in an improvement of gut health. Equally, fibre is important in the prevention of heart disease, colon cancer and diabetes [36]. The high dietary fibre content in pearl millet, which is 8% to 9% [32], improves bowl movement.



In addition, because of its low digestion features, it increases the transit time which reduces the rate of glucose in the blood; this helps the non-insulin-dependent diabetic patients. [37] reported lesser incidence of diabetes in people who eat millet. Moreover, fibre in millet may help reduce harmful cholesterol, while boosting valuable cholesterol. It also prevents the secretion of bile acids, which causes gallstones in the body [8]. Furthermore, pearl millet, with its high fibre content, helps slow down the movement of food from the stomach to the intestines. This leads to longer food interval durations, which in turn prevents obesity. On the other hand, neutral detergent fibre (NDF) and acid detergent fibre (ADF) in pearl millets are reported by [38] to be about 140 and 62 g/kg, respectively. The levels of ADF and NDF are crit- ical because they impact animal productivity and digestion in livestock production. Thus, the NDF and ADF is higher in finger than pearl millets, validating that pearl millets can be used in poultry feeds since chickens are unable to digest fibrous feedstuffs. Higher ADF and NDF contents in the feed ingredient are simply an indication of low energy, which was the case in finger millets.

3.1.6.Lipids

The content of fat in pearl millet is estimated to be about 5–7% [39] in comparison to 3.21–7.71% in maize [40]. In addition, [41] reported the percentage of lipid in finger and pearl millet to be 1% and 5%, respectively. Fatty acids such as palmitic, stearic, and linoleic acids are high in pearl millet, whilst oleic acid is found to be a low percentage in comparison to corn [10]. The overall lipid content in pearl millet grain ranges from 1.5 to 6.8%, which is higher than other millet varieties [9]. The free and bound lipid contents of pearl millet range from 5.6 to 6.1 and 0.6 to 0.9%, respectively. With triglycerides, diglycerides and monoglycerides have been identified as free and bound nonpolar lipid content in finger millet to be 5.2% (2.2% free lipids, 2.4% bound lipids, and 0.6% structural lipids). On the other hand, the major fatty acids recorded in finger millet were observed to be oleic, followed by palmitic and linoleic acids [43]. Saturated fatty acid accounts for 25.6% of finger millet's total fatty acids profile, while unsatu rated fatty acid accounts for 74.4% [43].

3.1.7. Macronutrients

Millet grain types vary in mineral composition as sum- marised in Table 2. Martínez-Ballesta [44] states that environmental stressors such as high salt levels, low water accessibility, and excessive temperatures, are found to affect the mineral content of food. Pearl millet consists of total mineral and trace elements, which is determined by the nature of soil. The content of ash in both pearl mil- let and corn ranges from 1.6 to 3.6% and 0.86 to 1.35%, respectively. With high concentrations of minerals such as calcium, phosphorus, magnesium, manganese, zinc, iron, and copper in pearl millet more than in corn [10]. Pearl millet is also considered a decent resource for fat- soluble vitamin E (2 mg/100 g) owing to its substantial oil content. The grain is also considered a good source of vitamin A [9]. Florence et al. [45], puts the calcium con- tent of pearl millet at 45.6 and 48.6 mg/100 g. It also has a large amount of phosphorus, which is an important mineral in the mineral matrix of bone, adenosine triphosphate or ATP, which is the energy booster in the body. It also helps in bone growth development and repair. However, some studies suggest that pearl millet has high amounts of iron together with many other factors such as phytates, oxalates and polyphones, which may interfere with the bioavailability of iron [46].

Finger millet on the other hand is rich in calcium and ranges from 162 mg/100 g to 487 mg/100 g, depending on the genotypes. [47]



In addition, [48] recorded the cal- cium content of finger millet to be between 189.93 mg per a hundred grammes (mg/100 g) to 1272.36 mg/100 g. Further to this, [49] recorded the calcium in pearl millet to be at the range of 31.77 and 728.71 mg/kg. Furthermore, report by [50] puts the calcium content in finger millet to be 344 mg/100 g. In addition, millets contain generous amount of magnesium, which is believed to have the ability to aid the body in fighting diseases such as cancer. Bachar et al. [48] reported a magnesium content of 84.71 mg/100 g to 567.45 mg/100 g in finger millet. Moreover, finger millet is considered a good source of natural calcium, which helps in bone strengthening and reducing the risk of bone fractures.

3.1.8.Health benefits of finger and pearl millets

Millet is consumed raw with multiple health benefits. It can also be transformed into fermented spinoffs, which are believed to add more benefits to human and animal health. Research shows that diets rich in plant food can protect against different kinds of diseases [51]. It is suggested by different authors that the presence of certain nutrients in millets lead to double benefit of nourishment and cure. Table 4 shows different phenolic compounds present in finger millet, their functions and health benefits.

3.1.9. Polyphenols

The main polyphenols such as phenolic acids and tan- nins are found in abundance in millet and are believed to act as antioxidants and play a vital role in boosting the body's immune system [52]. In addition, the coat of a finger millet seed, which contains phenols, has an antibacterial effect on Bacillus cereus [53]. Moreover, [37] indicate that millet phenolics can partially inhibit the enzymatic hydrolysis of complex carbohydrates, and consequently, inhibit malt amylase, and pancreatic amylase, which reduce postprandial hyperglycaemia. In a similar way, it is believed that ferulic and pcoumaric acids, which are found in whole pearl millet, have the capacity to reduce tumour cells [54]. In addition, [55] reported that the phenols available in millets have numerous health benefits and can act as an antioxidant, anti-inflammatory, and antiviral. Furthermore, celiac disease is a genetically susceptible problem triggered by the consumption of gluten. As the millets are gluten free, they help reduce celiac disease by reducing the irritation caused by common cereal grains that contain gluten. [56]. Millets contain phenolic acids that occur in a bound form (60%) as free molecules. The most common pheno- lics in millets are hydroxycinnamic acids and are mostly found in the insoluble-bound sections of phenolic acids[57]. The most common type of hydroxycinnamic acid is ferulic acid known as an antioxidant. Antioxidants are known nutrients that help minimise free radical damage to the body, and also have anti-inflammatory activity [58]. In addition, ferulate dimers have been found in millet grains and display high antioxidant activity [59]. Cereal ferulic acids have strong antioxidant activity in bound form, thus do not necessitate microbial activity during digestion to enable their release within the colon [60]. Furthermore, millet grains contain numerous flavonoids, comprising anthocynidins, chalcones, aminophenolics, flavanols, flavones, and flavanones [59]. Furthermore, dif- ferent millet varieties are also believed to contain proan- thocyanidins, also termed condensed tannins as reported by [61]. Significant levels of tannin are mostly observed in coloured millet varieties [17]. This finding was attributed to availability of condensed tannins since they contribute substantially to the grains colour. However, an abundance of condensed tannins may adversely affect the bioavail- ability of proteins and minerals [62].



3.1.10.Macro and micronutrient parameters

Water quality was not found to be detrimental to plant health, taking into account macroelements (N, P, K, Ca, Mg, and Na), which are considered necessary for the health of millet (N, P, K, Ca, Mg, and Na), as reported by Orhue (2005) and Rezapour et al. (2021). Domestic wastewater application significantly affected the content of macro-elements (N, P, K, Ca, Mg, and Na) in millet (Fig. 3). Plants irrigated with RWW produced the highest amounts of N with 6.7 \pm 0.91%, P with 6.2 \pm 1.1%, and K with 2.05 \pm 0.5%. However, the plants irrigated with WW had a high content of Ca with 0.3±0.8%, Na with 0.4±0.95%, and Mg with 0.1 ± 0.82 %. Furthermore, compared to RWW and WW, the TWW yielded a medium concentration of N (4.3±0.45%), P (5.62±1.2%, and K (1.85±0.15%, Ca (0.17±0.68%), Mg $(0.5\pm0.87\%)$, and Na $(1\pm0.96\%)$. This was the direct consequence of the important amount of nutrients provided by irrigation with RW, TWW by the Triuckling Filter system. Based on these results, it can be concluded that water irrigation significantly affects millet yield and mineral content. The enhancement of plant macronutrient content with domestic wastewater irrigation indicates that wastewater irrigation supplied the soil with these nutrients, which improved plant growth and soil fertility (Orhue et al., 2005). Indeed, plant growth and nutrient content can be enhanced by properly managed irrigation with preserved nutrients in treated wastewater (Alawsy et al., 2018). Consequently, TWW-irrigated plants showed medium levels of biomass production and nutrient content compared to those irrigated with RWW and WW. As we discussed previously, these treated wastewaters by TF system, in addition to the significant load of nutrients, meet standards for wastewater reuse in agriculture (Blumenthal et al. 2000; Moroccan standards 2007). The micronutrient contents (Fe, Zn, Mn, and Cu) of Zea mays treated by water of the three different qualities are shown in Fig.2. These micronutrients are necessary for plant nutrition only if they are required by the crops in much lower quantities compared to macronutrients (Elfanssi et al., 2018). The metrics indicate that Zea mays uptake a lower and similar content of micronutrients than RWW, TWW, and WW. These results were in line with prior research investigating the effect of short-term irrigation on micronutrient accumulation in plants (Adrover et al., 2012; Kiziloglu et al., 2008; Mapanda et al., 2005; Younas et al., 2022). Additionally, the accumulation of micronutrients might be affected directly by irrigation water quality or indirectly by an increase in the solubility of the native, insoluble soil micronutrient (El Moussaoui et al., 2019; Lucho-Constantino et al., 2005; Mapanda et al., 2005; Yu et al., 2007)

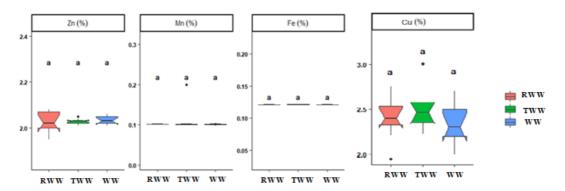


Fig. 2. The micronutrient contents (Fe, Mn, Cu, and Zn) of plant grain, irrigated by the three water treatments (RWW: raw wastewater; TWW: treated wastewater; WW: WW)

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Conclusion

In arid regions, treated wastewater is a valuable resource for irrigation as it provides water and some nutrients (N, P, and K) to crops. The present study reveals significant variations in the physicochemical and microbial characteristics of water and soil, as well as the physiological responses of millet crops, among the three types of irrigation waters investigated (WW, RWW, and TWW). The quality of TWW, treated using the Trickling Filter (TF) technology, has successfully met the permissible limits for reuse in irrigation without posing any health risks according to Moroccan standards. However, WW exhibits high salinity, with chloride concentrations surpassing the legal limits for water reuse in Morocco.Balanced dietary requirements are increasing with the growing population. Millets are a rich source of all nutrients and phytochemicals which combat chronic diseases. Due to their nutrientrich profile, millets could be the best option as potential cereal grain for human consumption. It has been demonstrated from the studied literature that pearl and finger millets have the potential to be used as an alternative source of energy in poultry diets. It has competitive nutrients equal to, or in some instances more than, conventional cereals such as maize, wheat and rice. In addition, the presence of nutraceuticals in the millets give them extra importance in terms of health benefits, especially for humans. The inclusion of up to 100% of millets can be added to broiler diets without having negative effects on the performance of chickens. Inclusion of millet in ruminants' animals' diets also had noticeable improvements on the performance parameters. This inclusion could eventually reduce the cost of feed for livestock production and consequently reduce the cost of livestock products for people who rely on it as source of protein. Because the grain is gluten free, it is considered one of the most suitable grain for the people with celiac diseases. Further to this, millet grains contain antinutrients that can have an adverse impact on nutrient bioavailability.

In conclusion, among the investigated irrigation water sources, TWW produced through the TF process could be considered the most suitable option for water reuse in agriculture and can serve as a valuable source of plant nutrients and soil fertilizers. TWW possesses significant nutritive value that can enhance plant growth, reduce the need for fertilizer application and associated costs, and ultimately improve the productivity of infertile soils. Nonetheless, further research is necessary to evaluate the long-term effects of TWW irrigation on soil and crops.

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PROTEIN METABOLISM AND LOW PROTEIN STRATEGIES IN DAIRY COW NUTRITION

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ABSTRACT

Ruminants require protein for their physiological processes, with rumen undegradable protein (RUP) and microbial protein (MP) being the main sources of amino acids (AA). Dairy cows use feed crude protein (CP) more efficiently than other ruminant animals, but they still excrete two to three times as much nitrogen in dung as in milk. This leads to increased nitrogen pollution and nitrogen excretion in the environment.Research is exploring the impact of lower dietary CP levels on milk yield and composition, but little is known about its effects on dairy cow fertility and health. Developing nutritional strategies to maximize nitrogen absorption, improve digestion, and optimize post-absorption utilization is crucial for high-yielding dairy cows. Formulating feed with balanced ruminally degradable CP can benefit the environment and economy. Keeping CP levels within acceptable level can also minimize nitrogen excretion. To improve protein quality and nutrient requirements, research is focused on lowprotein diets with rumen-protected, encapsulated protein.Low-protein dietary strategies have emerged as a focal point in ruminant nutrition due to their potential to enhance nitrogen efficiency and reduce environmental impacts. This review article aims to assess the effectiveness of low-protein dietary approaches and critically examine recent studies on protein metabolism in dairy cows.

Keywords: Ruminants, Protein, Dairy, Nitrogen Emmision, Rdp

1. INTRODUCTION

Ruminants require protein as a nutrient, and it is vital to their physiological processes. Rumen undegradable protein (RUP) and microbial protein (MP), which pass straight to the abomasum, are the two main sources of amino acids (AA) that ruminants primarily utilize. The maintenance needs and metabolizable protein demands of ruminants are largely covered by both sources [1].Ruminal bacteria produce high-quality protein and absorb recycled urea N that would otherwise be eliminated in the urine, so ruminants can effectively consume diets with low protein content or quality. Dairy cows use feed crude protein (CP; N x 6.25) far more efficiently than other ruminant animals yet, they still excrete two to three times as much nitrogen in dung as in milk. Ineffective N use makes it necessary to feed a lot of extra protein, which raises the cost of producing milk and adds to N pollution in the environment. Every lactation, a cow that produces over 18,000 pounds of milk also excretes roughly 23 tons of wet manure, which contains roughly 240 pounds of nitrogen [2].In ruminant nutrition, protein quality is currently a crucial component that has grown in importance.



It is important to note that raising the amount of crude protein (CP) in the diet of dairy cows does not immediately result in an increase in milk production [3]. Rather, it causes higher blood urea nitrogen levels, higher urine nitrogen excretion rates, and higher rumen NH3 concentrations [4]. Enhancing CP quality and establishing novel nutrient requirements for ruminants are the main goals of current research, especially with regard to low-protein diets enhanced with rumen-protected, encapsulated protein (limiting amino acids). There are various advantages to lowering the CP concentration in ruminant diets, such as decreased ammonia pollution, greenhouse gas (GHG) emissions, and nitrogen (N2) excretion. Additionally, according to Wu and Satter [5], it lowers soil and water pollution and boosts the profitability of animal feed. The effectiveness of dietary nitrogen conversion into milk protein in dairy cows is only about 26%, and the remaining nitrogen is eliminated by the orofaecal route [6]. According to Zou et al. [7], metabolic efficiency is significantly impacted by ruminal N2 losses. Microorganism-derived indigestible N2 can lower microbial protein content, which in turn lowers AA production and its presence in milk protein. Dairy calves excrete 72% of their nitrogen through the urinary system, according to Roque et al. [8]. Numerous protein kinds and sources, including rumen degradable protein (RDP), RUP, or MP, have been researched to reduce nitrogen losses in ruminants. However, it has proven difficult to identify the precise advantages of RDP, RUP, and MP in lowering animal urine N2 losses [9]. RDP is limited in ruminants because it is used for microbial protein synthesis (MPG) and can, in some circumstances, supply energy. MPG does not use RDP; instead, it is changed into NH3 and taken up by the liver through the ruminal wall. After detoxification to urea, it is eliminated in the urine [10].

According to Choi et al. [11], RDP is an essential component that enhances the flow of peptides and duodenal AA in ruminants. Furthermore, it has been demonstrated that RDP influences environmental toxic waste, cost-effectiveness, and ruminant production [12]. RUP is a significant source of AA, which is the main substrate for rumen growth and milk production and can be absorbed through the small intestine. The rumen microbiome uses the peptides, AA, and NH3 that are produced from the breakdown of ingested protein by ruminal microorganisms to produce MP. Nonetheless, the rumen's feed transit velocity affects the rate of MP synthesis. MP production helps make amino acids available, but it is unable to supply enough AA to satisfy the high-producing dairy cows' absolute AA balancing needs [12]. Providing sufficient levels of MCP to improve the absorption of AA in the small intestine (SI) of animals is the main goal of RDP administration. To preserve animal performance, highproducing ruminants' diets must be supplemented with rumen undegradable AA to boost AA flux in the SI [13]. Beyond the importance of RDP in diet composition, maintaining an adequate amino acid (AA) balance is essential for maintaining ruminant milk output, milk yield protein, and nitrogen utilization [14]. The economics of animal production are greatly influenced by feeding techniques, which are responsible for 70-75% of total production expenses [15].

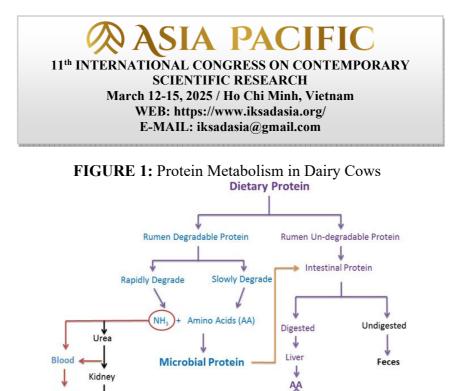
Research has indicated that adding 18% CP to sheep diets produced comparable body performance, feed conversion ratio (FCR), and dry matter intake (DMI) to diets supplemented with 16% CP.The diet containing 18% CP was more advantageous from an economic standpoint[16]. Kaya et al. [17] reported similar results. Thus, even in diets with low CP, adding the most limiting AA to the diet can lessen excessive N2 emissions into the atmosphere and lower contamination[16]. High-yielding dairy cows, especially those with low CP%, may benefit greatly from adding rumen-protected AA to their diet.



These advantages include lower environmental pollution, energy losses, and nitrogen excretion, as well as lower feeding expenses [1].Concerns have been raised globally on how ruminant emissions of greenhouse gases, nitrogen excretions, and atmospheric NH3 contribute to climate change and other environmental issues. Particularly, nitrogen losses put our natural regions at risk by contributing significantly to eutrophication, acidification, and water pollution [18].Since dietary N intake is the primary cause of N loss, low-protein diets are a viable way to reduce cattle's N excretions and NH3 emissions. Furthermore, the need to lower the amount of protein in dairy cow diets has been strengthened by the high expense and environmental impact of dietary protein (such as soy-based products) [19].Low-protein dietary strategies have emerged as a focal point in ruminant nutrition due to their potential to enhance nitrogen efficiency and reduce environmental impacts. This review article's aim is to assess the effectiveness of low-protein dietary approaches and critically examine recent studies on protein metabolism in dairy cows.

2. PROTEIN METABOLISM IN DAIRY COWS

Crude protein (CP), which is often defined for feedstuffs as the nitrogen content multiplied by 6.25, is referred to as dietary protein. The basis for this component is the 16% N content of the majority of proteins. Both protein and nonprotein N (NPN) are included in the computed CP content. There are two types of dietary protein: rumen-degradable protein (RDP) and rumen-undegradable protein (RUP). Rumen bacteria break down RDP, which is thereafter partially or completely skipped and converted into microbial protein. In contrast, RUP skips the rumen entirely. After leaving the stomach and entering the small intestine, the digesta is broken down and taken up by the bloodstream, while the proteins that have not been digested are expelled as feces. The AAs that are absorbed either enter the bloodstream or go via the liver to the kidneys. The AAs are converted into milk protein by the mammary glands before being released as milk.[Figure1]There is now increasing interest in lowering the protein content of dairy cow diets as a result of the combined effects of rising dietary protein costs and laws imposed in various countries regarding the application and storage of cattle slurry and manure[17,18,19]. According to the significant amounts of research, only about 25% to 35% of dietary protein is absorbed and secreted in milk; the majority of the remaining nitrogen is lost through feces and urine [20].Moreover, a meta-analysis of the effects of dietary protein concentration and degradability on milk protein yield and the effectiveness of using dietary N for milk protein synthesis came to the conclusion that the diet's CP concentration is the primary dietary factor influencing milk N efficiency and that lowering dietary CP is the most important way to improve the effectiveness of using dietary protein [21].



Research has started to evaluate how feeding lower dietary CP levels affects milk yield and composition, but little is known about how lower dietary CP affects the fertility and health of dairy cows. Developing nutritional strategies that maximize N capture in the rumen, improve N digestion and absorption in the lower gut, and improve post-absorption N utilisation and partition towards the mammary gland will be essential as we move towards a time when high-yielding dairy cows are fed low CP diets[6,9].Lower CP concentration diets that contain a balanced amount of ruminally degradable CP may benefit the environment and the economy. Meeting the needs of the rumen bacteria is the primary objective when formulating the feed for dairy cows in order to meet their protein requirements. The second objective is to balance the cow's need for metabolizable protein (MP). The total of the dietary protein that escapes the rumen undamaged and is subsequently absorbed in the small intestine, as well as the microbial CP that travels to the small intestine, is known as the MP requirement. It can be necessary to take into account an extra objective, such as keeping cows' CP levels within acceptable bounds in order to minimize N excretion [19].

Body Tissue Milk Protein

3. LOW PROTEIN STRATEGIES FOR DAIRY COWS

PH¹

Bladder

One crucial aspect of implementing low protein strategies is to ensure that the energy content of the diet is maintained. Cows require adequate energy to support milk production, reproduction, and body condition. Therefore, it's essential to balance the reduction of protein with increased energy sources, such as high-quality forages and concentrates rich in carbohydrates. This can ensure that the cows still meet their energy needs without being burdened by excessive protein.Moreover, utilizing feed additives that enhance the efficiency of protein utilization can further complement low protein diets. Ingredients like rumenprotected amino acids can help to meet the specific amino acid requirements of dairy cows even when overall protein intake is reduced. This means that while the protein content in the diet is lower, the cows can still receive the necessary nutrients for optimal milk yield and quality.It's also important to consider the forage quality in the diet. Forages with high digestibility can provide essential nutrients more efficiently, allowing for lower protein grain supplements while still supporting high levels of productivity.



3.1. UTILIZING PLANT EXTRACT OR HIGH EFFICIENCY FORAGES IN THE DIET

Improving N efficiency can be achieved by coordinating ruminal carbohydrate fermentation with RDP. According to Fan et al. (22), there has been significant N pollution and a significant loss of protein resources as a result of the feed's unbalanced amino acid composition and overly high CP content. Reducing the amount of CP or starch in feed can help ruminants retain more nitrogen, emit less nitrogen, or do both.According to Cantalapiedra-Hijar et al. (23), late-lactation cows' milk N efficiency rose and their urine N excretion reduced when the feed CP content dropped from 16.5% to 12%. Urinary nitrogen excretion (UNE) in dairy cows can be decreased by high feed use efficiency in cows fed a low dietary CP diet [24], whereas rumen NH3-N concentration and urinary N excretion from lactating dairy cows increased with increased CP concentration in feed [25]. In ruminants, several plants and their extracts can enhance N metabolism by increasing N retention, decreasing outputs, or doing both. Protein-tannin complexes, which are insoluble in the rumen, can shield feed N from being broken down into NH3 and eliminated by urine [26]. However, the kind and concentration of tannins determine their advantageous effects on ruminant N metabolism and the environment. Condensed tannins can be bound by polyethylene glycol, effectively controlling the interaction between proteins and tannins [27]. According to Souza et al. (28), adding tamarind (Tamarindus indica L.) residue silage to feed decreased fecal nitrogen excretion and improved lamb nitrogen retention. In both rumen and rumen simulation technique systems, Andrographis paniculata [29] or sainfoin (Onobrychis viciifolia) decreased NH3 concentrations in the rumen and enhanced nutritional digestibility and ruminal protein synthesis. Nigella sativa seeds and Rosmarinus officinalis leaves combined in the diet also reduced rumen NH3 and increased Dorper lamb weight gain[30].In dairy cows fed red clover silage, the percentage of ruminal undegraded dietary crude protein (RUP) rose [31]. Additionally, the amount of AAs, urine N excretion, and NH3 concentrations in the rumen decreased, all of which suggested a decrease in ruminal protein degradation [32]. By restricting the breakdown of proteins in the rumen, red clover's polyphenol oxidase (PPO) can catalyze the synthesis of o-quinones, which react with proteins to form stable complexes and lower N emissions [33]. According to Flythe and Kagan (34), phenolic extract from red clover suppressed the growth of Clostridium sticklandii, a Hyperammonia producing bacteria. According to Lee et al. (35), dactylis glomerata with a high PPO level also displayed a decrease in protein degradation products.Phenolic diterpenes are compounds that prevent microbes linked to protein breakdown. The leaves of Rosmarinus officinalis L., which contained carnosic acid and rosmarinic acid (a phenolic diterpene). inhibited the growth of Hyper-ammonia producing bacteria, such as C. aminophilum, and the genus Prevotella, which have the capacity to break down proteins and produce NH3. This could lower the concentration of NH3 in sheep [36].

To enhance animal health, antimicrobial peptides (AMPs) are also added to feed [37]. According to studies, goats' rumen microbiota structure improved, their feed utilization efficiency increased, and the rumen's NH3 content dramatically decreased after receiving AMPs [38].Dairy cows fed low-starch and low-sugar feed maintained the same amount of milk protein in the early stages of lactation as compared to those fed high-starch and sugar feed, provided that more AAs were catabolizing into urea. This suggests that dietary protein utilization is improved and environmental N pollution is decreased [39]. N retention and N emissions from ruminants can potentially be enhanced by concurrently modifying the crude protein to starch ratio.



Heifers' UNE and plasma urea levels were lowered, ruminal pH was improved, energy and N sources were synchronized, dry matter intake and N utilisation efficiency were further enhanced, and total mixed ration (10% CP and 13% ADF) and legume-based herbage (14% CP and 27% ADF) were mixed [40]. According to Cantalapiedra-Hijar et al. (23), a diet high in starch also increased milk N efficiency and lessened the detrimental effects of low crude protein feed on late-lactation cows' milk protein output.Feed treatment (including feeding method, forage maturity stage, and cutting time) seems to have varying impacts on ruminant N metabolism. Because alfalfa hay has a larger non-structural carbohydrate content, it can reduce fecal N concentration and improve feed N utilization efficiency when it is cut in the afternoon during the early growth period [41].

3.2. SUPPLEMENTATION WITH AMINO ACIDS TO MEET PROTEIN REQUIREMENTS

Reducing the protein percentage of the diet can improve dairy cows' milk N efficiency while lowering N excretions and NH3 emissions from manure. However, a lack of AA can impair milk composition and yield (MY). The earliest limiting EAAs for dairy cows are methionine and lys, but more recently, his has also been identified as limiting, particularly in diets that are poor in protein or grass.Considering dietary N intake is the primary cause of N loss, low-protein diets are a viable way to reduce cattle's N excretions and NH3 emissions. The need to lower the amount of protein in dairy cow diets has been encouraged by the high expense and environmental impact of dietary protein (such as soy-based products) [42]. However, reducing the diet's protein concentration may result in decreased rumen fiber digestibility, milk yield (MY), milk quality, and DMI [43].

Lower voluntary feed intake may be partially responsible for the unfavorable MY response to decreased dietary N intake [44]. However, in another study, cows fed a low-protein diet showed no change in MY [45].Reduced protein levels can result in a deficiency in one or more EAAs, which restricts the production of milk protein in nursing dairy cows [46]. According to NRC [47] and Schwab and Broderick (48), methionine and lys are the first and second limiting EAAs in nursing dairy cows at various intense production levels, respectively. His has recently been identified as the third limiting AA, particularly in meals high in grass or low in protein, where the majority of MP is supplied to the small intestine by microbial protein [49]. Furthermore, His is stored in endogenous labile pools seen in blood hemoglobin and muscle carnosine, which can conceal transient dietary His deficiency [50]. One effective way to avoid AA deficits may be to add rumen-protected (RP) supplements of the most limiting EAA to low-protein diets. Overall, there are several commercial products available for dairy producers, and the utilization of RP-Met and RP-Lys has been extensively documented in the literature. Additionally, there is growing interest in the use and development of RP-His sources because multiple experiments have demonstrated that adding RP-His to milk improved or tended to increase milk and milk protein yield (MPY), most likely in part by raising the DMI. Only when RP-Met and RP-Lys are sufficiently supplied in the food or supplemented will this impact be present [43,44].

When fed a diet lacking in metabolizeable protein, the DMI and Milk Yeild dropped in Lee et al. (44) 12-week long-term experiment. While adding RP-His to the MP-deficient diet further raised DMI and MY to a level comparable to an metabolizeable protein-adequate diet, adding RP-Lys and RP-Met to the metabolizeable protein-deficient diet tended to increase DMI and MY. While milk fat and real protein levels were unaltered, the Rumen Protectd Amino Acid supplement raised DMI, which in turn raised MY.



In the Giallongo et al. (43) study, providing a diet lacking in metabolizeable protein as opposed to one adequate in metabolizeable protein also resulted in a drop in DMI, MY, and milk components (fat, protein, and lactose).DMI was unaffected by adding RP-Met or RP-Lys to the metabolizeable protein-deficient diet, while DMI was raised to a comparable degree by adding RP-His (either by itself or in conjunction with RP-Met and RP-Lys) to the metabolizeable protein-adequate diet. Nevertheless, only adding all three RP-AA supplements to the MP-deficient diet numerically raised MY, but not as much as the metabolizeable protein-adequate diet.

Giallongo et al. (51) found that adding RP-His to a His-deficient diet that supplied enough Met and Lys had a favorable impact on MY. Although diets being somewhat inadequate for Lys (92 to 97% of the required and 95 to 99% of the requirement, respectively), Räisänen et al. (52) and Zang et al. (53) observed similar findings. However, the diet in the Giallongo et al. (43) study was more deficient in Lys (86 to 90% of the need), and MY was not improved by RP-His supplementation. His was the only RP-AA that was adequately supplied during the RP-AA period (MetLysHis group, 111% of the requirement) in an experiment because, when RP-Met and RP-Lys (and RP-His) were added to our diet, our diet (unintentionally) remained deficient for Met (91 to 93% of the requirement) and Lys (92 to 94% of the requirement) [54]. This is because the dAA supply from the diet was overestimated at the start of the trial, resulting in a higher than anticipated AA shortage. In an experiment, adding RP-Met, RP-Lys, and RP-His to the low-protein diet raised the MUN concentration; however, adding RP-Met and RP-Lys merely resulted in a statistical difference. Additionally, the UUN excretion was quantitatively increased by supplementing RP-AA (Met and Lys or Met, Lys, and His). Although studies have demonstrated links between MUN, PUN, UUN, and N excretion [55]. According to Lee et al. (44), cows fed a diet lacking in MP had lower levels of total EAA, Arg, His, Leu, Lys, Met, Phe, and Val in their plasma [pooled sample from d 69 and d 83 (3 samples per day)] than cows on a diet adequate in MP.

When fed an MP-deficient diet as opposed to an MP-adequate diet, Giallongo et al. (43) found that the plasma concentrations of total EAA and Arg, His, Ile, Leu, Lys, Phe, and Val were lower (plasma sample taken on d 35). Giallongo et al. (51) found that cows fed a Hisdeficient diet (+37 g/d MP) had lower plasma levels of His, Leu, Lys, and Val than cows on a His-adequate diet (+166 g/d MP)Giallongo et al. (56), on the other hand, saw no decrease in plasma levels for any EAA when administering a meal deficient in MP as opposed to one that was adequate for MP [assembled sample from d 38 and d 52 (3 samples per day)]. Variable EAA supply can result from varying diet compositions and feedstuffs, which could account for the diversity observed in the literature. The MetLys and MetLysHis groups had higher MUN concentrations, which would indicate a greater breakdown of excessive AA [57]. In the Lee et al. (44) research, supplementing RP-AA (Met + Lys or Met + Lys + His) had no influence on N balance or N excretion characteristics, but it did have a favorable effect on DMI and MY.

Three dietary CP contents (14.8, 16.8, and 18.7%) and two CP sources (solvent-extracted soybean meal and a combination of soybean meal and a blend of animal-marine protein supplements plus runnially protected methionine) were compared by Ipharraguerre and Clark [58]. When dietary CP was raised from 16.8% to 18.7% for early lactating cows (days 15 to 112) fed solvent-extracted soybean meal, DMI increased.



When dietary CP was raised from 14.8 to 16.8% for cows fed a combination of soybean meal, ruminally protected methionine, and a blend of animal marine protein supplements, DMI increased.Dietary CP content raised DMI in a related study [59], but it had no beneficial effects on the quantity of microbial N that entered the small intestine or on the ruminal fermentation of organic materials. In consideration of this, Ipharraguerre and Clark (58) hypothesized that the lower DMI for the low CP diet was most likely not caused by a lack of RDP, which hampered nutrient digestibility. According to Ipharraguerre and Clark (58), the larger dietary amount of NFC, especially starch, in low-protein diets may cause the liver to receive an enhanced supply of rumen propionate, which would signal hypophagia and lower DMI.

Groff and Wu (60) carried out four experiments in which the dietary CP content of the control diets was 16.6% (experimentation 1), 14.5% (experimentation 2), 15.7% (experimentation 3), and 16.2% (experimentation 4). Only in experiment 2 was milk output enhanced by raising CP by 20%, and this was linked to higher DMI. Dietary CP of the control diets was sufficient in the other three trials to optimize DMI and milk production. Cabrita et al. (61) found that diets high in citrus pulp and low in starch had higher DMI and milk output when dietary CP was raised from 13.2 to 15.2%. Elevated dietary CP had no effect on milk output or DMI for starch-rich diets. According to Cyriac et al. (62), increasing dietary CP from 13.6 to 16.8% resulted in a linear rise in DMI and milk yield.Law et al. (63) found that when dietary CP rose from 11.4 to 14.4%, both milk yield and DMI increased.Nevertheless, milk output increased but DMI did not when dietary CP was raised to 17.3%.

3.3. SUPPLEMENTTION WITH RUMEN PROTECTED ESSENTIAL AMINO ACIDS

The best option for post-ruminally delivering AAs is artificially infused EAAs; however, this method is not relevant at the herd level. In order to provide EAAs to the small intestine without being broken down by rumen bacteria, several rumen-protected (RP) AA products have been created. With varying degrees of success, RP-AAs, Met, Lys, or both have been extensively researched and implemented. The effectiveness of these RP-AA products largely depends on their ability to withstand the harsh rumen environment while still being released in an effective manner in the small intestine. Various encapsulation techniques and materials have been developed to enhance the protection of these amino acids, allowing them to bypass the rumen and subsequently be absorbed in the lower digestive tract. Two RP-Met studies were conducted on Holstein dairy cows that were fed diets based on corn silage and alfalfa [64].In trial 1, the milk yield (+1.9 kg) was considerably higher for treatments of 17.3% CP plus 5 g of RP-Met and 16.1% CP plus 10 g of RP-Met than for the 18.6% CP with no supplementation group; the milk protein yield remained unchanged. The addition of 10 g of RP-Met to meals containing 17.3% or 16.1% CP produced comparable milk production and composition to the group that did not receive RP-Met. The milk protein content of earlylactating dairy cows fed 14.5% CP and RP-Met (0.03% of diets) tended to decrease because of the numerical drop in milk protein [65] yield.Early-lactating Holstein cows fed diets based on corn (17.0% of CP) and alfalfa (2.03 kg/d) had higher milk and milk protein outputs when supplemented with RP-Lys at a rate of about 94.4 g/d/cow [66].

The RP-Lys supply tended to boost milk and milk protein production (0.82 kg/d and 20 g/d, respectively) in the same study including mid-lactating cows. However, when early-lactating Holstein cows were fed corn silage-based diets (16.4% of CP) with 10 or 20% of dried distillers grains plus solubles, comparable milk production levels were also observed as being between 0 and 60 g/d of RP-Lys-supplemented groups.



[67]Early-lactating Holstein dairy cows fed alfalfa hay and heated whole soybean-based diets (19.5% of CP) were used to assess the effects of RP-Met and RP-Met with RP-Lys [68].Supplementing 5.25 and 10.5 g/d of RP-Met resulted in a linear rise in milk protein content and yield. In contrast to the 10.5 g/d RP-Met group, the addition of RP-Met plus RPLys (11.5 and 14.7 g/d, respectively) did not result in any modifications [69]. In contrast to the aforementioned experiment, when Holstein dairy cows were fed corn-based diets containing 16.0% or 18.5% of dietary CP, the supplementation of 40 g/d of RP-Met and Lys product enhanced both milk and milk protein production in comparison to the 15 g/d RP-Met group [70]. Early-lactating Holstein cows fed maize silage and cereal-based diets (14.5% of CP) were given tablets containing either RP-Met (18.2 g/d supply), RP-Lys (11.7 g/d supply), or both [71].

Milk and milk protein yields were unaffected by RP-Met or RP-Lys alone, however the combination of RP-Met and RP-Lys enhanced the milk protein output. A meta analysis was carried out to estimate the effects of RP-Met on milk production and milk protein [71].According to study, RP-Met supply would result in 27 g of genuine milk protein content and yield (true milk protein: milk $CP \times 0.94$), as well as 0.07% more product. The authors of the same study also examined the potential effects of AA deficiency and forage sources on true milk protein. The findings indicated that both yield and true milk protein content would rise, irrespective of the primary forage source (alfalfa, corn silage, grass, or grass + corn silage) and the state of the AAs (adequate or deficient Met, Met + Lys, or Met + Lys + one other AA).Overall, the meta-analysis and the previously stated research suggest that supplementing dairy cows with RP-Met may boost their milk protein output under a variety of circumstances. The effects of RP-His, with or without RP-Met and RP-Lys, on milk production were examined after His was deemed a first-limiting AA. Mid-lactating Holstein dairy cows on diets based on corn silage (15.1% of CP, comprising 11 g/d of RPMet) were supplemented with progressively higher quantities of RP-His (0, 82, 164, and 246 g/d) [72]. Both milk yield and milk protein yield showed a tendency to increase (quadratically and linearly), with 256 g/d of RP-His actually increasing milk protein yield by +50 g/d. Morris and Kononoff (73) examined the effects of RP-Lys, RP-His, or both in Jersey dairy cows fed hydrolyzed feather meal (a His-deficient feed) together with diets based on corn silage (17.1% of CP). A supply of RP-His (32 g/d) resulted in a significant improvement in milk yield and a tendency towards an increase in milk protein yield, while supplementation with 70 g/d of RP-Lys had no effect on milk production [73].

In a few studies, the impact of His was examined when cows were fed metabolizable protein (MP)-deficient diets (MPDs) [74–76]. In comparison to the MPD without supplementation group, a supply of MPD (13.6% of CP; diets based on corn silage and alfalfa haylage) with RP-Met (30 g/d/cow) plus RP-Lys (100 g/d/cow) with or without RP-His (50 g/d/cow) increased milk protein yield. The resulting yield was comparable to that of the MP-adequate (MPA; 15.7% of CP) diet group. However, the effect of RP-His was not confirmed in comparison to MPD with RP-Met and RP-Lys [76]. In Holstein dairy cows fed diets based on corn silage, the effects of MPD, slow-release urea, RP-Met (30 g/d), and RP-His (50 g/d) on dairy cow productivity were calculated [75].MPD (14.8% of CP), MPD plus urea (15.8% of CP), and RP-Met had no effect on milk protein synthesis; however, RP-His did. Additionally, the milk protein output (90 g/d) was higher when MPD was supplemented with RP-His plus urea and RP-Met than when MPA was used (16.7% of CP). MPD, RP-Met, Lys, and His were all examined by the same author [74].



When compared to MPD, the milk protein yield in the Met, Lys, and His alone groups only showed numerical changes (average 14.5% of CP); however, when MPD was given a mixture of three AAs, the milk protein yield increased by 100 g/d. Additional research on the effects of RP-His is still necessary because of the variety of effects and the limitations of these investigations. Other AAs have also been studied, including RP-Leu [77], RP-Phe [78-80], RP-Trp [81], RP-AAs (combination of Lys, Ile, Val, and His in RP form) [82], and others. Milk protein synthesis in mammary cells requires absorption of AA from arterial blood, and uptake is believed to be a function of AA concentrations in arterial blood and the mammary blood flow rate. In addition, intramammary metabolism allows certain AA to compensate for low circulating levels of other AA, and the mammary gland's "pull" of essential AA may reduce hepatic catabolism of certain essential AA in coordination with mammary set points for protein synthesis [83].Because of the impact of extra-mammary organs on arterial amino acid concentrations and local modulation of milk blood flow, milk protein output may not react in accordance with a limiting AA phenomenon. For instance, supplementing histidine to an abomasal infusate of essential AA without histidine reduced mammary blood flow in lactating goats, but had no effect on the mammary gland's net uptake of histidine [84]. As an alternative to the first-limited AA theory, Nichols (83) suggested that the more correct statement is that any critical AA can be limiting once the mammary gland's ability to adjust to different AA supplies has been compromised.In fact methionine and lysine, two rumenprotected AAs, may occasionally produce favorable effects when taken as supplements. The gland's ability to obtain other necessary AA from the diet will determine the return on that response (marginal response) in terms of milk N efficiency.

Single AA supplementation may also have negative consequences on dairy cows. These could result from induced metabolic imbalances that lead to energy-intensive processes for catabolism and excretion of excess AA[85] or from decreased net transport of individual AA into mammary cells as a result of increased competition for limited transport capacity via countertransport systems [86].

4. IMPLICATIONS OF LOW PROTEIN STRATEGIES

4.1. Effects on milk production and quality

Early lactation milk production is influenced by the quantity of CP in the diet. Research investigating the impact of varying CP concentrations throughout the early stages of lactation consistently shows that lower CP levels result in less milk being produced. Wu and Satter (87) investigated the effects of varying CP concentrations in order to assess the production response of 58 multiparous Holstein cows. They compared the diets of cows fed three distinct amounts of CP (154, 174, and 193 g/kg of DM) from day 1 to day 112 of lactation . During this time, cows fed the 154 CP diet produced significantly less milk on average per day than cows fed the 174 CP diet. Cows provided 174 CP diets produced 1.3 kg less milk per day on average than cows fed 193 CP diets, although this difference was not statistically significant (P > 0.05). It is possible that the body's protein stores were exhausted by week seven, according to Wu and Satter (87). Cows on a high-protein diet could thus reach a greater peak production, but cows on a low-protein diet could no longer increase their milk production. In a different study, Law et al. (88) used 45 primiparous and 45 multiparous Holstein-Friesian dairy cows to examine the impact of varying protein levels on milk production during early lactation.



The impacts on calculated energy balance and nitrogen efficiency were assessed, which makes the study intriguing. In order to investigate the effects on animal production, energy metabolism, blood parameters, and nitrogen efficiency during early lactation, three dietary CP concentrations (114, 144, and 173 g/kg DM) were examined throughout the first 150 days of lactation.Milk yield, milk fat content, total milk fat yield, total milk protein yield, and milk energy output all significantly decreased (P<0.001) when the dietary protein concentration dropped. Compared to cows fed the CP 144 and 173 diets, cows receiving the CP 114 diet had a noticeably lower DMI. Compared to cows on the CP 144 and 173 diets, cows fed the CP 114 diet consumed substantially less ME. Cows fed the CP 114 diet had a substantially higher cumulative energy balance than cows on the CP 173 diet when the milk energy output was taken into account. Law et al. (88) came to the conclusion that increased milk production caused by a higher dietary CP content considerably raised the average daily ME requirement. The concept of lowering the CP concentration in the diet may be a useful strategy to enhance the energy balance during the early stages of lactation (although at the expense of milk output) is also supported by this statement.Law et al (88) assessed the impact on milk Nefficiency, or milk N:N intake. They found that a lower CP content significantly (P < 0.001) increased N-efficiency for the first 150 DIM, which is consistent with research on the relationship between CP and N excretion and ammonia emissions [89, for example, and Dijkstra et al., 2013 in theory), as well as model simulations using the Dutch Tier 3 for enteric methane emission to measure the impact of N mitigating feeding practices on N excretion [90].In addition to early lactation, it's important to consider about how increasing the CP content in the diet in the middle of lactation affects milk supply. The DMI and milk output were considerably increased by increasing the protein concentration from 114 to 144 g/kg of DM at 151 DIM. The DMI was considerably increased by increasing the protein concentration from 144 to 173 g/kg of DM. If the protein concentration was changed from 144 to 173 g/kg of DM, milk output increased by 1.9 kg/d; however, the difference was not statistically significant (P > 0.05). Leonardi et al. (91) found no impact of dietary CP content on the DMI and milk yield of dairy cows when dietary CP was raised from 16.1 to 18.9% and from 16.5 to 18.5%, respectively. On the contrary, Broderick (92) found that increasing dietary CP from 15.1 to 16.7 and 18.3% resulted in a linear increase in DMI; however, only the first CP increment caused milk yield to increase from 33.0 to 34.1 kg/d, with no change occurring at 18.3% CP. This led to a lower feed efficiency (milk/DMI) at the highest CP.CP levels in red clover and alfalfa silages are roughly 180 to 200 g/kg of DM under normal management conditions. Corn silage has 70 to 90 g of CP/kg of DM, while grass silage has 100 to 160 g. [93]According to several studies [94-96], adding up to 66% red clover or alfalfa silage to the forage component of dairy cow diets increased DMI, milk output, and the amount of PUFA in milk.Red clover has also been shown to improve the omasal flow of AA and increase the efficiency of microbial protein (MCP) synthesis in the rumen when compared to grass silage [94]. The only exception to this is methionine, which was lower in cows fed red clover as opposed to grass silage [97]. Higher alfalfa silage inclusion rates of up to 75%, however, have been demonstrated to have an adverse influence on milk production [96].Although feeding diets high in CP (>175 g CP/kg DM) might enhance the amount of MP that enters the gut, high-CP diets usually lead to low nitrogen utilization efficiency (NUE; milk N/N intake), with higher RDP causing the rumen to produce excess ammonia[98]. According to Schwab and Broderick (99), this extra ammonia is taken up by the blood, transformed into urea in the liver, and then eliminated in the urine.



The degradation of terrestrial and aquatic ecosystems can be attributed to the subsequent loss of excreted nitrogen to the environment [99]. However, it has been demonstrated that giving lower-CP diets (<165 g CP/kg DM) increases N utilization and decreases urine N excretion [100]. Still, in high-yielding dairy cows, concentrations below 150 g CP/kg DM may reduce DMI, which in turn may reduce milk output [101, 102]. In a diet based on red clover and grass silage or alfalfa and corn silage that was expected to meet or be slightly deficient in MP supply, lowering the dietary CP concentration from 175 to 150 g/kg of DM decreased DMI but had no effect on milk yield or composition. In contrast, raising the percentage of alfalfa in a low-CP diet from 50 to 60% of the forage DM decreased milk yield and milk protein content but not DMI or ECM yield. When dietary CP was reduced in a diet based on red clover and grass silage, but not in one based on alfalfa and corn silage, the apparent wholetract nutritional digestibility was reduced. Crucially, dairy cows' perceived nitrogen utilization efficiency increased by about 25% when fed a low-CP diet composed of either alfalfa and corn silage or red clover and grass silage[103].Lactation performance has frequently been found to decrease when dietary CP concentration is decreased [101]. According to Giallongo et al. (104), when cows were fed a 1:2 (DM basis) ration consisting of alfalfa haylage and corn silage, milk output decreased by about 4.3 kg/d when the concentration of dietary CP was decreased from 165 to 145 g/kg of DM (leading in a 5 to 10% shortfall in MP supply). On the other hand, Barros et al. (105) found that feeding a low-CP (144 g of CP/kg of DM) alfalfa and corn silage-based diet (48:52 ratio, DM basis) had no influence on milk performance and had no effect on milk output or composition.Dairy cows fed a high proportion of alfalfa-based diet as opposed to a low one showed decreased milk output and milk protein concentration (75:25 vs. 25:75 alfalfa to corn silage ratio[106]. The alfalfa silage's ME density may have contributed to the drop in milk output and milk protein content as the quantity of alfalfa increased. This could have resulted in a reduced supply of rumenavailable energy and subsequent MCP flow to the duodenum. But according to a number of studies, switching from corn to alfalfa silage has minimal consistent impact on milk content or yield [107-109]. In addition, it has been suggested that enhancing the MP's AA profile, specifically the limiting necessary AA like lysine, methionine, or histidine, could increase milk and milk protein supply [104]. According to Alstrup et al. (110), cows fed a low-CP diet based on corn and grass silage (139 g/kg of DM) as opposed to a higher-CP diet (157 g CP/kg of DM) showed no change in plasma glucose or BHB concentrations, but their plasma urea levels decreased by 1.17 mmol/L.Giallongo et al. (104) found that feeding dairy cows a low-CP diet consisting of alfalfa and corn silage (145 to 148 g/kg of DM) resulted in a lower concentration of PUFA in milk fat. This effect was linked to the addition of dietary heattreated or expeller soybean meal, which had a higher saturated fat content.

4.2. Impact on overall cow health and reproduction

According to Sinclair et al. (109) and Arndt et al. (108), substituting alfalfa silage for corn had little effect on apparent nutritional digestibility, with the exception of fiber digestibility, which rose as alfalfa silage inclusion rates increased [108]. The apparent digestibility of CP may be decreased by providing alfalfa-based diets, which may increase the flow of indigestible fiber through the duodenum and cause more endogenous cells to slough off the intestinal wall [95].Several studies have shown that feeding alfalfa or alfalfa and corn silage-based rations to lactating dairy cows can increase apparent NUE. For example, feeding dietary CP from 175 to 150 g/kg of DM while keeping the MP supply constant increased NUE by about 25% [111-113].



Research has demonstrated that increasing the percentage of alfalfa silage in diets based on corn silage to 75 or 80% reduces NUE. This could be related to a decrease in milk yield, an excess of RDP, or a restriction of rumen available energy in rations that contain a lot of alfalfa silage [106,108]. According to Garnsworthy and Jones' (114) research, cows with a high BCS of approximately 3.5 were fed a diet high in rumen bypass protein had a significantly higher energy mobilization of body energy reserves than cows with the same BCS who were fed a diet low in rumen bypass protein. Hristov et al. (115) demonstrated that variations in plasma histidine concentrations due to increased rumen-protected histidine supplementation were greater for longer experiment durations (70 d) than for shorter experiment durations (28 d).According to Law et al. [116], the lowest protein diet (114 g/kg DM) had a greater incidence rate of metritis. The commencement of luteal activity, pregnancy to first service, services per conception, 100 d in-calf rate, and calving interval were all found to be unaffected by protein content. the cumulative energy balance for the highest protein diet (173 g/kg DM) during the first 150 days of lactation was significantly negative, while the cumulative energy balance for the lowest protein diet (114 g/kg DM) was positive. According to Law et al. study [116,117], lowering the dietary CP concentration increased the efficiency of N consumption for milk protein synthesis while lowering milk output and DMI. During the first 150 days of lactation, high-protein diets increased DMI and milk production; however, a medium-protein diet suffices after that. The 144-144 g CP/kg DM treatment appears to provide the greatest improvement in milk yield per unit increase in N-losses when compared to the minimal CP allowance of 114-114 g CP/kg DM. The amount of protein in the diet has no effect on fertility. It is possible that a shift in the dietary CP content from high (173 g/kg DM) to low (144 g/kg DM) during lactation (at week 21 of lactation) caused the cow to use labile protein sources for milk production during an adaptation period, which was followed by a period of decreased milk production as these labile protein sources ran out. It is assumed that the low CP diet of 114 g CP/kg DM, compared to 144 g/kg DM and above, increased the incidence of metritis in dairy cattle. According to Wu and Satter's (87) study, lowering the dietary CP concentration improved the efficiency of N use for milk protein synthesis while decreasing milk output and DMI. Performance was at its peak during the first 30 weeks of lactation with a protein concentration of 174 g/kg DM; after 30 weeks, performance could be negatively impacted by a protein content of 160 g/kg DM. The 174 going to 160 g CP/kg DM treatment seems to produce the greatest improvement in milk yield per unit of increase in losses when compared to the treatment of 154 going to 160 g CP/kg DM as minimum CP allowance.Reducing dietary CP from 170 to 131 g/kg DM, but not from 185 to 170 g/kg DM, decreased milk output and DMI; lowering dietary CP always improved N-utilization efficiency, according to the findings of the Tolkamp et al. (118) study. Cows were able to choose a high CP diet of 170 g/kg DM when given the option. The study of Reynolds et al. (119) & Crompton et al. (120) found that lowering dietary CP from 160 to 140 g/kg DM generally decreased milk production and DMI, but that lowering dietary CP from 180 to 160 g/kg DM had no effect on either of these parameters; a decrease in dietary CP always improved N-utilization efficiency. The range of 140 to 160 g CP/kg DM seems to be the ideal dietary CP level, which correlates a rise in milk yield with an increase in nitrogen losses in manure.



The amount of CP in the diet had no effect on the fertility of dairy cattle.In comparison to the other two higher CP treatments, the health of the cows undergoing the 140 g CP/kg DM therapy appears to be compromised.Although there may be adverse effects of low-CP diets on intake and performance, it has been reported that if the diets are designed to maximize MCP synthesis and provide enough MP, the CP concentration in dairy cow diets can be lowered to about 140 to 150 g/kg DM without having an adverse effect on the health, fertility, or performance of the cows [102].

It has been shown that L-Met supplementation in vitro increases protein synthesis in cells that form epidermal horns [121], while the in vivo response is less clear. There was no discernible impact on the rates of growth or hoof horn wear, for instance, and Laven and Livesey (122) found no benefit to additional rumen-protected Met (115% vs. 95% of requirements) on solar hemorrhages or locomotion score in dairy cattle [123]. Clark and Rakes (124) have noted that supplementing with amino acids has been linked to an increase in hoof growth, although this has not always been linked to an increase in hoof hardness. Study showing no benefit to supplementation have typically been carried out with low-yielding cows [122], the apparent discrepancy in response in vitro and in vivo may be partially explained by the relative requirements for S-containing amino acids, particularly Met, for milk production. As genetic capacity for milk production increases, it is possible that the positive effects of more Met on solar lesions and lameness will become more apparent.Neutrophils and lymphocytes perform less effectively when lactation begins [125], and leucocytes use glutamine in particular for nucleotide production at high rates [126]. Reducing the protein feed to ewes in late gestation has been reported to lower their immunological response and increase the periparturient rise in fecal egg counts [127]. However, the effects on dairy cows are less clear. Although some studies [128,129] have suggested that reduced dietary protein or amino acid supplementation increases the risk of retained placenta and metabolic disease, there are generally few studies that have been specifically created to investigate into the impact of protein level on cow health.Met has been suggested to play a significant role in enhancing the immune system in dairy cattle. It was demonstrated that giving mid-lactation dairy cows a relatively high dose (30 g/day) of rumen-protected Met supplement increased the proliferative response of peripheral T-lymphocytes, while having no effect on milk SCC [130].

There has been no positive impact on SCC from other studies that have looked at Met supplementation [131,132].Reduced dietary protein intake during the early stages of lactation is linked to a rise in adipose tissue's reactivity to lipolytic stimuli like epinephrine and a fall in its reactivity to anti-lipolytic stimuli like insulin . Therefore, it would be expected that a net decrease in body fat mobilization would result from a declining supply of tissue amino acids. When given diets with a high by-pass protein content, Jones and Garnsworthy (133) showed that cows with a high BCS had a bigger negative energy balance, but not cows with a poor condition score. Furthermore, a higher DM consumption is frequently linked to a higher dietary protein intake or DUP supply, which lowers the need for body tissue mobilization. Met acts as a methyl donor for the liver's production of phosphotidylcholine and apolipoprotein B100. These metabolites are essential for the synthesis of carnitine, which is needed for the uptake of long-chain fatty acids across mitochondrial membranes, as well as for the hepatic generation of VLDL [134].Low plasma Met concentrations are strongly associated with severe liver steatosis in dairy cows that have undergone periparturient periods, and a lack of Met may limit hepatic VLDL generation [135].



Nevertheless, there has been no conclusive benefit from controlled studies that have examined the response to supplemental Met [136,137]. The actual impact of Met on energy metabolism in the early stages of lactation is unknown, as some have observed an increase in hepatic lipid concentrations[138].

In a meta-analysis of the relationship between dietary CP and pregnancy rate, Lean et al. (139) found that cows fed diets with higher or more biodegradable CP within the dietary CP range of 111 to 230 g/kg had an overall 9% (P=0.019; 95% CI 2% to 16%) lower chance of conception.A study by Aboozar et al. (140) found that cows fed high levels of rumen UDP improved a variety of reproductive characteristics, while few studies have specifically examined the impact of dietary protein type on fertility measures. Prior research on twinsuckling beef cows[141] and dairy cows [142] showed that raising the amount of DUP in the diet can improve fertility when linked to lower plasma urea concentrations. These advantages in modern high-yielding dairy cows need more verification. However, in the study by Garnsworthy et al. (143), ovarian function was unaffected even though changes to the protein level and amino acid balance changed metabolic hormones and milk production.Milk or plasma urea concentrations can be used to measure dietary CP intake. Numerous studies have employed urea measurements to evaluate the connections between metabolite levels and reproductive metrics. For many years, plasma urea levels above 6.8 mmol/l have been regarded as a sign of detrimental effects on reproduction[144]. However, the outcomes of the many investigations into the relationship between circulating urea levels and fertility in dairy cattle have been inconsistent.Research has shown that cows with higher plasma urea levels (>7.5 mmol/l) have lower conception rates [145], however other research have not shown any connection [146,147]. A study conducted in Poland (148) found significant connections between milk urea and several reproductive indices, however the related R values were low (usually between 0.01 and 0.07), highlighting how shaky these relationships were. Indeed, blood urea levels had little bearing on the benefits of dietary protein on conception rate, according to a recent and thorough meta-analysis on the subject by Lean et al. [139]. It has been demonstrated that a number of dietary protein correlates, such as urea and ammonia, affect reproductive function at the ovarian and uterine levels [140]. Although the effects of feeding high protein diets are inconsistent, in vitro studies have demonstrated that high ammonia/urea can hinder oocyte development [150,151].

Ocon and Hansen (152) found that 7.5 mM urea during in vitro maturation had detrimental impacts on the subsequent development of blastocysts, but not 10 mM. Rhoads et al. (153) reported negative effects of high urea in donor but not recipient animals after day 7 embryo transfers in nursing dairy cows, suggesting that the oocyte/blastocyst is more vulnerable than the developing embryo. It has been proposed that the uterus, where increased urea is linked to lowering uterine pH, may be the primary site of action for the elevated ammonia/urea linked to feeding high protein diets [154].The oviductal environment may be more significant, though, as in vitro research indicates that the time of reproductive vulnerability may begin before the embryo enters the uterus.Carroll et al. (155) found that cows on high-protein and low-protein diets had comparable rates of conception, while their uterine urea levels varied greatly.Therefore, no clear mechanism has been demonstrated, despite the identification of several possible sites of action via which dietary protein can directly alter reproductive function.

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5. CONCLUSION

Implementing low protein diet into dairy cow management is a great opportunity to optimize animal welfare and production efficiency. By carefully analyzing protein diet, we may reduce environmental impacts and considerably reduce nitrogen excretion while maintaining milk production and quality. Formulating diets with an emphasis on energy balance, using alternative feed sources, and accelerating up microbial protein production are all successful strategies.Additionally, this strategy will be further enhanced by upcoming studies on precision feeding and the nutritional requirements of individual cows, making low-protein diets profitable and sustainable.

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THE USE OF ESSENTIAL OILS IN DOG NUTRITION, HEALTH BENEFITS AND SAFETY CONCERNS

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ABSTRACT

Essential oils (EOs) have gained popularity as a natural and holistic approach to pet health, with their potential medical benefits and potential to resolve various pet problems. The demand for EOs for pets is driven by the growing awareness of the connection between diet and health, as well as the need to reduce synthetic chemicals used in pet care.Pet food companies use certain chemicals as antioxidants to prevent free radical formation, regulate feed oxidation reactions, and maintain feed quality and organoleptic properties. Pet owners are adding nutritional supplements like tea polyphenols, quercetin, and curcumin to their pets' diets due to their growing awareness of the connection between diet and health. Plant extracts, which come from various natural sources, have antibacterial, anti-inflammatory, and antioxidant properties. They are being added to the diets of fish, pets, and farm animals to improve health. However, the use and potential of plant extracts in pet nutrition have not been thoroughly investigated. Natural antioxidants can prolong the shelf life and improve storage quality of pet food by lowering lipid peroxidation and protein oxidation. These compounds can also be used as supplemental medicines in the treatment of diseases and as feed additives or ingredients to keep dogs and cats healthy and lower their risk of developing drug resistance. The accessibility of essential oils has significantly expanded in recent years, thus this review article seeks to meticulously examine the utilization of essential oils in canine nutrition, the advantages for health, and potential safety considerations.

Keywords: Cannine, Nutrition, Essential Oils, Health

1. INTRODUCTION

The use of essential oils (EOs) in pet food is a novel approach to solve the problems related to pet health[1]. EOs have gained popularity recently because of its important biological and pharmacological qualities[2]. EOs have been shown to exhibit antibacterial, anticancer, low-haemolytic, and antioxidant properties [1,2,3]. EOs are complex mixtures of volatile, nonpolar chemicals that are extremely concentrated. They are classified as secondary metabolites in plants and are essential to the plants' ability to flourish in their particular settings [3]. These mixtures contain a range of substances with potential uses in different pharmacological situations, such as terpenes, terpenoids, and phenylpropanoids [4]. A number of important variables may be responsible for the demand for EOs for pets. First of all, natural and holistic methods of pet care are becoming more and more popular among pet owners.



Plant-based essential oils (EOs) are thought to be a more natural substitute for traditional pet supplies. Second, EOs are well-known for their possible medical advantages. Numerous typical pet problems can be resolved by them . Numerous pet owners want to reduce the amount of synthetic chemicals used in their pets' care, and the natural approach [5] fits with this goal. With a large variety of products designed especially for pets, EOs have become much more accessible and available in recent years, making it easier for pet owners to use EOs in their wellness regimens.Commercial pet diets are designed to satisfy particular nutrient requirements in order to support the different physiological states of cats and dogs [6]. The pet food business uses some chemicals as antioxidants because they prevent free radicals from forming, regulate feed oxidation reactions, and maintain the feed's organoleptic qualities, nutritional safety, and quality [7].Pet owners are adding nutritional supplements like tea polyphenols, quercetin, and curcumin to their pets' diets as a result of their growing awareness of the connection between diet and health in recent years[8]. The main and secondary metabolites found in plant extracts, which come from a variety of natural sources, include plant polysaccharides, polyphenols, alkaloids, flavonoids, glycosides, terpenes, and volatile oils[8,9]. These substances have antibacterial, anti-inflammatory, and antioxidant properties, among other biological actions. In an effort to improve health, polyphenols and other bioactive substances are currently being added to the diets of fish, pets, and farm animals. The use and potential of plant extracts in the nutrition of dogs and cats, however, have not yet been thoroughly investigated. There are still many aspects of the mechanisms that underlie these plant metabolites' actions that need to be examined and clarified.Additionally, problems with pet food storage and the toxicity of artificial antioxidants like sulfites and ethoxyquin can be resolved with plant extracts [9]. Plant extracts, which are naturally occurring antioxidants, can prolong the shelf life and improve the storage quality of pet food by lowering lipid peroxidation and protein oxidation [9,10]. Specifically, medicinal plants can be used as supplemental medicines in the treatment of disease since they contain a variety of physiologically active compounds [10,11]. Furthermore, by acting as feed additives or ingredients, these naturally occurring bioactive compounds may help keep dogs and cats healthy and lower their risk of developing drug resistance[11].Researchers and pet food companies have proposed dual-purpose ingredients in high-quality pet food, where natural antiviral products have gained popularity[12]. It is crucial to note, though, that these natural products can also be toxic to animals, necessitating precautions and the determination of appropriate dosages, much like with chemical products, in order to be able to offer a safe product. Due to their potential as inhibitory agents for microorganisms, spices and their derivatives agents that add flavor and texture acquired a prominent role, offering a fresh viewpoint on the animal feed sector. The availability of essential oils (EOs) has significantly improved in recent years, especially with the introduction of numerous products designed especially for use in dogs. Because of this advancement, it is now more convenient for pet owners to include essential oils in their pets' daily care and wellness regimens. These products' rising popularity is a reflection of people's increased understanding of the potential advantages of essential oils (EOs) in enhancing animals' health and wellbeing. The goal of this review is to give a detailed summary of the properties, safety concerns, potential issues, and noteworthy benefits of essential oils for pet health as well as their makeup and characteristics.



Additionally, it will explore the restrictions and difficulties related to the application of essential oils in pet care, making sure that pet owners are aware of the advantages and potential disadvantages of including these natural treatments into their pets' treatment plans.

2. COMPOSITION OF ESSENTIAL OILS

Essential oils (EOs) are highly concentrated aromatic compounds that are derived from a variety of plants and are well known for their medicinal and fragrant qualities. Knowing the chemical components of EOs is essential to understanding how they could affect biological systems. Due to global market need, researchers have recently become interested in examining the components of EOs.

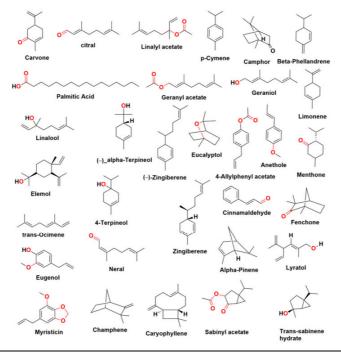


FIGURE 1; The chemical structure of major compounds of representative essential oils [21]

Rosemary essential oil

Rosmarinus officinalis, often known as rosemary, is a member of the Labiatae or Laminaceae family. The plant's leaves and blossoming branches have therapeutic qualities. The essential oil is extracted from the dry leaves or flowering plant.Camphor, α -pinene, borneol, 1,8-cineol, and α -terpineol were identified as the primary constituents of rosemary essential oil. The location and time of harvest had a substantial impact on the essential oil makeup of the samples.

Key components of rosemary essential oil include eucalyptol (9.48% to 12.58%). Significant levels of eucalyptol (25.9% to 22.7%), borneol (12.43% to 14.09%), and camphor (9.61% to 5.76%) are also present in lavender essential oil.Rosmarinic acid, caffeic acid, salicylate, and other natural substances including flavonoids, phenolic acids, diterpenes, triterpenes, tannins, bitter substances, resin, saponin, protein, fat, carbohydrate, fiber, certain salts, and vitamins are examples of chemical compounds.[13]



Ferulago contracta essential oil

The perennial plant chaville (Ferulago contracta) is a member of the Umbelliferace family. Bornyl ester (13.42% to 14.32%), trans- β -Ocimene (11.52% to 6.78%), and limonene (8.93% to 3.34%) comprise Ferulago contracta EO (F. contracta). These elements are essential for establishing each oil's unique aromatic signature.[13]

Peppermint essential oil

Major constituents of peppermint essential oil (EO) include menthol, menthone, 1,8-cineole, menthofuran, and isomenthyl acetate, which together account for a sizeable amount of the EO (72.4%) [14].

Four distinct seasons have varied compositions, according to a study on peppermint essential oil composition. Menthone (31.85%), menthofuran (25.83%), isopulegone (15.60%), and menthol (13.32%) were the main constituents during the summer. Menthofuran (48.01%), pulegone (23.60%), and menthone (14.63%) were the constituents in the fall. Menthone (42.67%), menthofuran (22.95%), and menthol (18.77%) were present during the winter. Menthone (44.51%), isopulegone (22.79%), and menthol in the summer, the main ingredients were the same in the spring and summer. Autumn featured a high concentration of the pulegone chemical, whereas winter had a high quantity of menthol [15].

Cymbopogon essential oil

Cymbopogon spp. EO contains citral (90.4%), geraniol (37.1%), and α -elemol (29.5% to 53.1%) in various sections, including roots, root hair with stalk, and leaves [15].The composition of the leaves and roots of Cymbopogon martinii EO (C. martinii) differs. The main constituents of roots are α -elemol (31.5%), neral (16.6%), and geranial (25.0%), whereas neral (36.1%) and geranial (53.1%) are found in leaves. [16]

Lemongrass essential oil

Lemongrass essential oil distinguishes between roots and leaves. The primary component of lemongrass essential oil is citral, which ranges in concentration from 30.07 percent to 93.28%. The aldehyde compound citral has two geometric isomers: geranial (citral b) and neral (citral a).Geraniol predominates in leaves (76.6%), with geranyl acetate coming in second (15.2%). Geranyl acetate makes up 4.4% of roots, but geraniol makes up the majority (87.9%) [16].

Eucalyptus essential oil

Eucalyptus essential oil is distinguished by its high 1,8-cineole concentration, which accounts for roughly 63.1% of its makeup. A variety of monoterpene hydrocarbons are also present in it, such as p-cymene, α -pinene, α -limonene, γ -terpinene, β -pinene, and β -myrcene [17].

Citrus angustifolia essential oil

Citrus angustifolia EO is also known as L. angustifolia. Its high content of linally acetate (27.5%) and linalool (24.1%) accounts for 51.6% of the oil's formulation. E-ocimene, terpinen-4-ol, caryophyllene, carvacrol, lavandulyl acetate, (Z)-ocimene, (Z)-ocimene, and (Z)-ocimene are further important chemicals. The quality of the EO is mostly determined by these components [18].



Oregano essentil oils

Oregano essential oil is mostly composed of carvacrol (76.64–85.70%), o-cymene (3.61–5.00%), γ -terpinene (1.83–3.47%), β -bisabolene (0.02–3.00%), E-caryophyllene (0.98–2.93%), linalool (0.39–2.48%), thymol (1.65–2.43%), and bornol (0.26–1.35%).[19]

Lavender Essential oils

A member of the Lamiaceae family is lavender (Lavandula officinalis L.). Its blossoms and flowering branches are distilled to produce its essential oil, a yellow or pale yellow liquid with a strong, bitter flavor. Apart from almost 16 percent of linally acetate, its essential oil also contains free linalool, gerambol, butyric, propionic, and valeric acids [20].

2. PROPERTIES OF ESSENTIAL OILS

Independent applications of EOs have shown a variety of biological effects, including as insecticidal, antibacterial, antioxidant, immunomodulatory and anti-inflammatory qualities.[22]

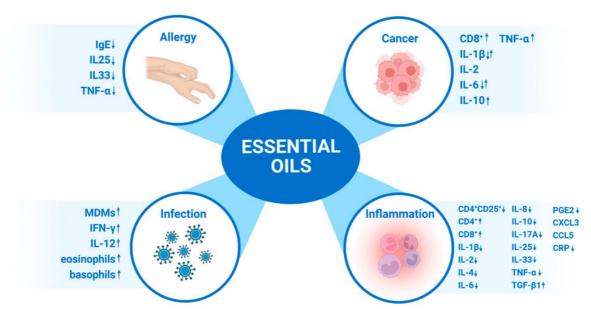


FIGURE 2. Immunomodulatory and anti-inflammatory properties of essential oils[22].

3.1. Anti inflammatory Activity

By using immune system components like antibodies, cytokines, and dendritic cells [23], essential oils may also boost the immune system and eventually replace traditional treatment for a variety of illnesses and other health issues, including cancer, allergies, wounds, and inflammatory diseases [24].Certain essential oils have the potential to promote the growth of immune-competent cells, such as B and T lymphocytes, natural killer cells, dendritic cells, macrophages, and polymorphonuclear leukocytes [25]. Eucalyptus essential oil components, for example, promote macrophage phagocytosis [26], whereas Nigella sativa essential oil inhibits CD4+ and CD8+ lymphocyte growth in vitro [27].Traditional medicine uses the wild plant Myrtus communis (also known as myrtle) to treat stomachaches, wound healing, hemorrhoids, and other conditions [28].



Its leaves, fruits, roots, and berries exhibit anti-inflammatory, analgesic, antioxidant, anticancer, anti-diabetic, anti-mutagenic, and neuroprotective properties [29]. In traditional herbal medicine, it releases essential oils with antibacterial (against Staphylococcus aureus, Listeria monocytogenes, Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae, etc.), antifungal (against Candida spp., etc.), insecticidal, antioxidant, and anti-inflammatory qualities. Terpenes, terpenoids, and phenylpropanoids are abundant in these essential oils [30].Essential oils derived from Chamaecyparis obtusa have immunomodulatory effects on mucosal inflammation brought on by home dust mites. The cypress species Chamaecyparis obtusa (C. obtuse, Cupressaceae) is widely distributed in central Japan and southern Korea. It yields essential oils that include monoterpenes, sesquiterpene hydrocarbons, and oxygenated sesquiterpenes, among other compounds. It has anti-inflammatory, antibacterial, and antiatopic qualities as well [31].

In a dose-dependent manner, the essential oil dramatically inhibits the release of IL-25 and IL-33 from epithelial cells, which are important modulators of Th2 immune responses and may arise in response to allergens linked to the emergence of airway allergic inflammation [32,33]. Additionally, it inhibits the expression and activity of nuclear-kappa B factor (NF- κ B) and activator protein 1 (AP-1), which prevents bronchial epithelial cells from producing IL-6 and IL-8, as well as prostaglandins (PGs) and TNF gene expression, thereby preventing LPS-induced inflammation [29]. Therefore, it might have an impact on the innate and adaptive immune responses that contribute to inflammation. Particularly, the viability of nasal epithelial cells treated with allergens linked to the development of airway allergic inflammation was unaffected by an essential oil concentration of less than 0.1%. Additionally, some researchers claim that the plain oil extracted from C. obtusa was roughly ten times more toxic to nasal epithelial cells than its microencapsulated form [34].

Black cumin seeds are produced by the Nigella sativa plant (N. sativa, Ranunculaceae) family. Ancient herbalists referred to the seeds as "herbs from heaven" [35]. Because of its advantageous qualities, it has been used to treat a wide range of illnesses, including rheumatism, asthma, bronchitis, headaches, back pain, paralysis, inflammation, and hypertension [36]. They may also have an impact on bacterial and viral infections, ischemia, oxidative stress, autophagy failure, and inflammation. Furthermore, this essential oil's topical use demonstrated antibacterial and local anesthetic properties in addition to aiding in the removal of eczema and blisters [37]. Thymoquinone, thymohydroquinone, dithymoquinone, nigellone, thymol, carvacrol, α - and β -pinene, d-limonene, d-citronellol, p-cymene, carvacrol, trans-anethole, 4-terpineol, longifolene, and α -hederin are among its primary ingredients [38,39]. Thymoquinone is the most physiologically active component. The essential oil extracted from black cumin also shows good anti-inflammatory action linked to the presence of thymoquinone, according to several investigations conducted on animal models [40]. In LPS-stimulated murine macrophage-like RAW264.7 cells, Hossen et al. demonstrated that it influences the activity of pro-inflammatory factors (TNF, IL-6, and IL-1B) [41]. Furthermore, Ebrahimi et al. demonstrated that in ovalbumin (OVA)-sensitized rats, similar to the asthma paradigm, a-hederin given at a dose of 0.02 mg/kg alters miRNA-133a expression and influences IL-2 and IL-17 secretion pathways [42].

It should be noted that in human pre-adipocytes with low-grade inflammation, freshly extracted essential oil lowered the amount of IL-6, whereas stored oil decreased the level of IL-1 β [43].



In rats with carrageenan-induced paw edema, it also altered the levels of pro-inflammatory cytokines (IL-6, IL-12, and TNF) in paw exudates and sera at a 400 mg/kg dose [44]. Furthermore, in rats with paw edema, external application of a balm stick containing 10% essential oil inhibits edema (60.64%), lowers the leukocyte count (43.55% lower than control), and lowers the TNF level (50% lower than control), all of which significantly reduce acute and sub-acute inflammation at the site of inflammation [40]. The activation of anti-inflammatory signaling pathways (NF- κ B and TLR signaling) is linked to its capacity to reduce inflammation. It can boost immunity in a number of ways, including: 1. both innate and adaptive immune components are modulated; 2. pro-survival and pro-apoptotic signals (PI3K/Akt, JNK, and mTOR) are upregulated and downregulated, respectively, to prevent apoptosis; 3. autophagy is induced (SIRT1 signaling); 4. energy metabolism priming (AMPK-SIRT1-PGC-1 α and PPAR γ signaling); 5. the growth factor pathway is stimulated (PI3K/Akt signaling); 6. Protein clearance is caused by the overexpression of lipoprotein receptor-related protein 1 (LRP1). [45]

Furthermore, cumin essential oil has been shown to protect against neuroinflammation linked to Alzheimer's disease by lowering the expression of cytokines (IL-2, IL-4, IL-6, IL-10, and IL-17a) and chemokines (CXCL3 and C-C motif ligand 5 [CCL5]) in LPS/IFN- γ or H2O2-activated BV-2 microglial cells [46]. By triggering autophagy through SIRT1 activation and nuclear accumulation in LPS-activated BV-2 microglia, it may also provide protection against neuroinflammation [47]. Furthermore, cumin essential oil exacerbates inflammatory processes in the Alzheimer's disease model by downregulating the expression of TLR signaling components, their downstream NF- κ B effectors, and interferon regulatory factor 3 (IRF-3) [48].The capacity of T. vulgaris essential oil to reduce the synthesis of proinflammatory cytokines is likely responsible for its anti-inflammatory properties [49].According to Ocaña et al., T. vulgaris EO can promote inflammation by decreasing the release of inflammatory mediators like TNF, IL-1 β , C-reactive protein (CRP), and IL-8 and increasing the synthesis of anti-inflammatory mediators like IL-10 [50].

The main components of essential oils that appear to be involved in this process are pcymene, which inhibits NF- κ B and mitogen-activated protein kinase (MAPK) signaling pathways and influences TNF and IL-1 β secretion, and thymol, which alters the characteristics of an inflammatory process marker called elastase, which is produced by activated neutrophils and inhibits cyclooxygenase (COX) [51,52]. In particular, thymol and carvacrol can inhibit the activity of transcription factors like AP-1 and nuclear factors of activated T cells (NFAT), which are in charge of starting the production of cytokines in T cells. Additionally, it has the capacity to halt the synthesis of IFN- γ and IL-2, which impacts T cell activation [53]. When compared to the control group, Ismail et al. found that giving T. vulgaris essential oil to animals infected with E. coli O157:H7 dramatically reduced serum levels of TNF, IL-6, and IL-8 [54]. According to published findings, thyme essential oil may also have an impact on the production of IFN- γ and LPS-mediated nitric oxide [54].

Thujone, 1,8-cineole, camphor, borneol, and methyl cinnamate are oxygenated monoterpenes that are known to aid in wound healing and are linked to the anti-inflammatory and antioxidant properties of A. judaica essential oil. Additionally, 1,8-cineole downregulates 5lipoxygenase (LOX) and COX and inhibits the inflammatory markers TNF, IL-6, IL-8, leukotriene B4 (LTB4), PGE 2, and IL-1 [55,56].

Since ancient Egypt, patchouli (Pogostemon cablin, P. cablin) essential oil has been recognized for its therapeutic qualities.



Notably, it can alter the inflammatory milieu of ApcMin/+ mice, differentiate M1 to M2 macrophage phenotypes, and stimulate CD4+ and CD8+ cells in the treated mice's spleen, blood, mesenteric lymph nodes (MLNs), and Peyer's patches (PPs) [57]. Tetradium ruticarpum, also known as Euodia ruticarpa (E. ruticarpia) (Rutaceae), exhibits antiinflammatory and anti-cancer characteristics. It has been used to treat bacterial infections, headaches, nausea, vomiting, diarrhea, pelvic inflammation, and abdominal pain after eating [58]. Yeh et al. [58]claim that the anti-cancer effects of E. ruticarpa are caused by the primary components of steam-distilled essential oil, including 2-(3-methoxyphenyl)-4H-1benzopyran-4-one, N,N0-diphenyl-1,4-benzenediamine, benzoic acid, N-propylbenzamide, and dipropylene glycol dibenzoate.By controlling splenocytes' production of Th1 (IL-2) and Th2 (IL-10) cytokines, they can suppress the PC-3 prostate cancer cell line (the spleen is solely involved in immunological activities in the human body) [59]. One of the most wellknown plants in the Myrtaceae family, eucalyptus, is used to treat wound infections and inflammation [60]. These days, it also aids in the treatment of respiratory and viral illnesses [61,62]. Its primary component, 1,8-cineole, commonly referred to as eucalyptol, and terpenes like limonene and α -pinene exhibit a variety of biological functions [63,64]. For example, when applied topically to IgE-mediated allergic dermatitis, it reduces edema and increases vascular permeability. Additionally, it might boost the immune system, including the respiratory tract's immunological function. Additionally, it can be utilized as an adjuvant for certain inflammatory and infectious illnesses. In vitro, this essential oil can increase the activity of monocyte-derived macrophages (MDM) [65,66].

3.2. Antioxidant Properties

The total antioxidant status (TAS) and total oxidant status (TOS) of broilers fed thyme and rosemary essential oils showed numerically reduced values. all groups (3-day-old male broiler chicks (Ross 308) were randomly divided into five groups of 80 animals each treatment, for a total of 400 chicks) that received thyme and rosemary essential oils showed markedly higher levels of SOD activity and glutathione (GSH) as well as lower levels of MDA in the breast muscle. both groups' levels of catalase (CAT) activity in the broiler breast muscle were statistically comparable (p > 0.05). Additionally, was found that dietary supplementation of thyme EO and REO decreased TAS levels (p < 0.05) while increasing the oxidative stress index (OSI) and TOS levels. Intestinal morphology and antioxidant metabolism were improved by the dietary thyme EO and rosemary EO doses that were studied (Control: Basal diet alone, Thyme-1: Basal diet + 0.15 g kg-1 of thyme EO, Thyme-2: Basal diet+0.30 g kg-1 of thyme EO, Rosemary-1: Basal diet + 0.10 g kg-1 of Rosemary EO, and Rosemary-2: Basal diet + 0.20 g kg-1 of REO) [67].

Zhang et al. [68] showed how natural oregano essential oil affected the antioxidant qualities of 21-day-old broiler serum. Serum levels of glutathione peroxidase (GSH-Px) and superoxide dismutase (SOD) were considerably greater in broilers given antibiotics, natural oregano EO, and synthetic oregano EO than in the control group. Additionally, serum glutathione reductase (GR) concentration rose when natural and synthetic oregano essential oils were added to the diet. On day 21, dietary synthetic oregano EO supplementation had no effect on the malondialdehyde (MDA) level, although dietary antibiotics and natural oregano EO supplementation caused it to drop. There was no difference in the serum MDA proportion between the four treatments on day 42.

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However, when compared to the control, the serum quantities of GR and SOD were elevated by both synthetic and natural oregano EO supplements. Furthermore, compared to birds fed a control diet, those fed synthetic oregano EO, natural oregano EO, and antibiotics showed higher serum concentrations of GSH-Px and total antioxidant capacity (TAC) [68].

When compared to the basal diet feed control group (CON), the experimental group's laying hens had noticeably higher levels of TAC ($9.8 \pm 0.8 \text{ mmol/L}$). In contrast, the experimental group's MDA levels ($10.7 \pm 1.4 \text{ nmol/mg}$) were significantly lower than those of the CON group. GSH-Px levels were consistently elevated in birds fed with oregano EO. Furthermore, the quantities of aspartate transferase and alanine were considerably lower in the experimental group [69].

Thymus algeriensis (T. algeriensis) essential oil (TAEO) has a mean IC50 value of 2.7 mg/mL and has been shown to decrease 2,2-diphenyl-1-picrylhydrazyl (DPPHi) and 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid (ABTS i+) radicals. Additionally, with an IC50 value of 512 mg/mL, TAEO demonstrated the ability to scavenge hydrogen peroxide (H2O2). As evidenced by its reducing power in the TAC assay (313 mg ascorbic acid equivalent (AAE)/g of EO) and ferrous iron reduction (25.4 mg AAE/g TAEO), TAEO was found to include electron transport networks. As demonstrated by the b-carotene bleaching assay, the lipophilic character of TAEO components greatly suppressed oxidation reactions in lipidic systems (55.5% at 5 mg/mL). Nevertheless, TAEO was unable to bond with ferrous ions at the amount of concentration evaluated (1–10 mg/mL) [70].

When pigs were supplemented with EO blend (EOB) (100 mg EOB/kg food (EO100); 200 mg EOB/kg diet (EO200); or 400 mg EOB/kg diet (EO400)), the observed increase in SOD activity is thought to be beneficial, as GSH levels did not decrease. EOB efficiently activates the antioxidant defense mechanism without increasing the concentrations of reactive oxygen species (ROS). Due to its role in neutralizing H2O2, GSH levels would have dropped if ROS had grown. This emphasizes the importance of researching these substances to understand their effectiveness in weaned pigs' diet. When 200 and 400 mg of EOB/kg of food were added, oxidative stress decreased. It was advantageous for nursery piglets' liver antioxidant status as well as their blood biochemical and hematological profiles. [71].

3.3. Antimicrobial Activity

It has been demonstrated that essential oils exhibit varying degrees of antibacterial activity in proportion to both the bacterium and the oils. Significant variations have been noted between bacterial species and, within a species, between strains.EOs mainly cause cellular structural instability in bacterial pathogens, which compromises membrane integrity and interferes with numerous cellular functions, such as energy production and membrane transport. Moreover, EO-induced membrane rupture can identify ion loss and cellular component leakage.[72]Since antibiotic-resistant types of bacteria pose a serious threat to both human and veterinary health, research into the antibacterial qualities of essential oils is becoming more and more popular. Alternative pharmacological therapies are welcome to help fight these illnesses.

The problem of antibiotic resistance arises from the overuse of antibiotics, mostly in veterinary care and animal farming. Antibiotic residues in animal-derived foods (meat, milk, eggs, fish, and honey) and the environment, however, are additional problems associated with the use of these medications.

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The primary source of environmental contamination is animal dung. The majority of antibiotics can be metabolized by the body after they are administered. In essence, the parent medication and/or its metabolites are eliminated through the urine and/or feces. The animal will expel antibiotics through its feces if they have inadequate oral absorption [73]. However, the number of studies verifying their in vivo use to treat animal infections is very small. Therefore, EOs with antibacterial properties could be a promising alternative.Clove (Syzygium aromaticum) and cinnamon (Cinnamomum zeylanicum) essential oils shown strong antibacterial action against E. coli strains isolated from chickens with colibacillosis, either alone or in combination [74].

Other research have also shown that the two oils' primary constituents, eugenol and its acetate form, may be connected to their actions [75]. Cinnamon EO reduces the permeability and integrity of the E. coli membrane, which results in the loss of internal cell components, according to Zhang et al. [76]. Rhayour and colleagues [77] discovered that clove EO had a comparable effect on E. coli, exhibiting damage in the form of holes in the cell wall and membrane.In vitro anti-E. coli action was demonstrated by other EOs. It has been demonstrated that litsea cubeba essential oil works well against E. coli [72]. The presence of aldehydes as geranial and neral was mostly responsible for the holes and gaps Li et al. [78] saw on the outer and inner membranes of E. coli cells treated with this EO. The primary constituents of Cymbopogon citratus EO, which shown strong in vitro activity against E. coli isolates, are also these aldheydes [72,79]. Additionally, Mentha piperita EO demonstrated strong anti-E. coli action [72,80]. Menthol and its oxidative product, menthone, were identified as the main constituents of peppermint essential oil's antibacterial qualities [81,82].EOs from Pelargonium graveolens and Ocimum basilicum demonstrated anti-E. coli action [72,83,84]. The large concentrations of oxygenated monoterpenes in geranium EO appear to dictate its antibacterial property [72], whereas the significant amount of linalool in basil EO has been linked to its activity, albeit to varying degrees, in relation to the tested strain [84].

Multidrug-resistant E. Coli isolates from dogs with cystitis were tested in vitro against essential oils (EOs) derived from thymus (Thymus vulgaris), clary sage (Salvia sclarea), origanum (Origanum vulgare), basil (O. basilicum), and star anise (Illicium verum). All EOs had anti-E. coli action, however oregano and thyme produced the best results [85].In food microbiology, the application of essential oils (EOs) to fight Salmonella infections was primarily studied. In actuality, foodborne illnesses caused by Salmonella species pose a growing risk to human health; outbreaks of salmonellosis are exacerbated by recent changes in human society related to food processing and marketing practices that use live breeders [86].Consumers now have serious health concerns about salmonella strains that are resistant to market antibiotics. Additionally, strains of this genus cause sickness in pets and farm animals, which can lead to financial losses and the possibility of human transmission. Fifteen distinct Salmonella enterica serovar Heidelberg strains that were isolated from a variety of sources, including people, cattle, pigs, poultry and poultry egg houses, and turkey, were evaluated against the oils R (+)-limonene, orange terpenes, cold compressed orange oil, and trans-cinnamaldehyde.While R (+)-limonene and orange terpenes had no inhibitory action against the same bacteria, carvacrol and trans-cinnamaldehyde totally inhibited the development of all S. Heidelberg isolates; only two isolates were affected by cold compressed orange oil [87].



Poultry-isolated strains of S. enterica serovar Enteritidis and S. enterica serovar Thyphimurium have been evaluated against essential oils derived from Aloysia triphylla, C. zeylanicum, C. citratus, L. cubeba, M. piperita, and S. aromaticum. These serovars are significant zoonotic infections linked to serious illnesses in humans, animals, and birds. The anti-Salmonella activity of C. zeylanicum was the strongest, while S. aromaticum EO came in second. It has been proposed that an integrated strategy to prevent Salmonella intestine colonization involves the use of these EOs in poultry diets in conjunction with the delivery of Saccharomyces cerevisiae. Additionally, EOs derived from S. aromaticum and C. zeylanicum may be used separately or in combination for disinfection in a farm setting [88]. These EOs' primary constituents-cinnamaldehyde, which is found in C. zeylanicum EO, and eugenol, which is found in both C. zeylanicum and S. aromaticum-have been linked to their antibacterial action. These compounds' capacity to donate hydrogen causes them to react with lipid and hydroxyl radicals, turning them into stable products [89]. Furthermore, because the two substances include a carbonyl group that binds and inactivates the bacterium's important enzymes and/or damages their cell walls, they can prevent the bacteria from producing these enzymes [90]. In addition to their possible antibacterial properties, EOs appear to enhance the quality of meat and egg production, which makes their application in poultry nutrition a topic of study [91].

Zhang et al. [92] investigated the in vivo effects of EOs in combination with organic acids (EOA) on hens challenged with Salmonella enterica serovar Enteritidis. Two different kinds of combinations were tested. The capacity of certain EOs, such as cinnamonomum, to prevent the growth of this pathogen and the development of biofilm was investigated by Kavanaugh et al. [93]. In vitro, P. aeruginosa was effectively killed by the oils of cassia (Cinnamomum aromaticum), clove (S. aromaticum), Peru balsam (Myroxylon balsamum), red thyme (T. vulgaris), and tea tree (Melaleuca alternifolia). Additionally, the EOs of cassia, red thyme, and Peru balsam were effective in inhibiting the formation of biofilms. In other investigations, T. vulgaris EO demonstrated efficacy against P. aeruginosa by preventing the in vitro development of clinically multidrug-resistant isolates of humans [94].

When comparing commercial EOs, such as T. vulgaris oil, to a P. aeruginosa strain isolated from a dog with externa otitis, unimpressive results were observed. The strain was shown to be resistant to multiple antibiotics. Oils from Roman chamomile (Anthemis nobilis), star anise (I. verum), lavender (Lavandula hybrida), litsea (L. cubeba), basil (O. basilicum), oregano (O. vulgare subsp. hirticum), rosemary (Rosmarinus officinalis), and clary sage (S. sclarea) were also employed to evaluate the canine strain.

While the other EOs, including thyme, have no effect, only S. sclarea, O. basilicum, and R. officinalis exhibited scarce activity [95].EOs from clove (S. aromaticum), lemongrass (Cymbopogon flexuosus), and cinnamon bark (C. zeylanicum) were tested on 20 clinical multidrug isolates of P. aeruginosa in humans. The oils with the strongest activity against all were cinnamon bark, lemongrass, and clove. Additionally, when cinnamon oil was linked to cinnamonaldehyde, encouraging outcomes were seen; in fact, all isolates showed increased bactericidal activity [96].A strain of P. aeruginosa was susceptible to the effects of Pinus eldarica bark essential oil [97]

According to the findings of various studies, active essential oils are those that contain certain compounds; specifically, the compounds that were found to be most effective against C. jejuni were cinnamonaldehyde, estragole, carvacrol, benzaldehyde, citral, thymol, eugenol, perillaldehyde, carvone R, and geranyl acetate [98].

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Campylobacter species can also infect mammals. Dogs and cats, in particular, can be asymptomatic or exhibit clinical indications related to the gastrointestinal tract, but they are always a risk of infection for their owners. It is possible that canine and feline isolates may be sensitive to EOs that have been demonstrated to be effective against Campylobacter strains of different origin, however studies assessing the impact of EOs against pet-isolated strains of the bacteria are not accessible in the literature. Examining whether in vitro effective EOs may be used in these animal species as a substitute for or in addition to traditional medications to boost antibacterial activity and/or strengthen the immune system in a manner similar to that observed in chicken may be of interest. In farm animals, staphylococcal infections may also pose a serious financial risk.O. vulgare and T. vulgaris essential oils' primary constituents, carvacrol and thymol, have been shown in numerous investigations to have anti-staphylococcal activity [95].

Nevertheless, it has been demonstrated that EOs derived from other plant species are similarly efficient against staphylococci.Good anti-staphylococcal action was demonstrated by Satureja montana EO [95]. Prior observations of S. montana EO's antibacterial efficacy against a few Gram-positive and Gram-negative bacteria linked it to key components such carvacrol. Specifically, Vitanza et al. [99] discovered that S. aureus displayed unbroken cell wall breakdown when exposed to S. montana EO.Ebani and colleagues [95] discovered that whereas EOs from Commiphora myrrha and C. zeylanicum showed no activity against S. xylosus, they exhibited modest activity against some canine isolates of the species S. aureus, S. pseudointermedius, S. chromogenes, and S. hyicus. Certain essential oils' in vitro antibacterial activity was evaluated against four methicillin-resistant and four methicillin-susceptible canine cutaneous clinical isolates of S. pseudointermedius.C. zeylanicum, M. officinalis, Leptospermum scoparium, S. montana, and C. citratus EOs produced the strongest efficacy against all strains [100].Studies have demonstrated that S. aureus is susceptible to the essential oils of lemongrass (C. citratus) and lemon balm (M. officinalis) [101,102].

An in vivo experiment was conducted to assess the modifying effect of a meal containing clove (S. aromaticum) essential oil on the antioxidant and immunological status of Nile tilapia after Streptococcus iniae infection. Fish protection to bacterial challenges was boosted by clove essential oil.Furthermore, it was demonstrated that this oil's antibacterial action was partially mediated by hepatic hepcidin expression [103].S. aromaticum showed good activity against S. mutans, too, and eugenol was identified as the maincompound that influences the antimicrobial activity [104,105]. Citrus fruit essential oils often have very little antidermatophyte action. In particular, it was shown that Citrus limon EO was ineffective against M. canis [106], various dermatophytes [107], Pompia, Citrus medica, and Citrus bergamia [108. When evaluated at 10%, Citrus × myrtifolia showed no antimycotic action, while only one of the three cultivars of C. bergamia (C. bergamia v. fantastico) and Citrus japonica EOs would have a modest activity (0.5%) against M. canis, M. gypseum, and T. mentagrophytes. The majority of citrus species have high concentrations of limonene, which has a MIC > 10% [108] and would have no effect on M. canis; nevertheless, Chee et al. [109] report a 0.5% fungicidal activity against the anthropophilic Trichophyton rubrum. A common component of Australian traditional medicine, tea tree (M. alternifolia) oil has demonstrated a moderate effect on Trichophyton equinum, the causative agent of equine ringworm, both in vitro [110] and in vivo [111].



4. Impact of Essential Oils on the Health Status of Dog

A mix of essential oils was utilized to treat Malassezia otitis (M. otitis) externa in atopic dogs. While R. officinalis, S. sclarea, and Lavandula hybrida (L. hybrida) had greater MIC levels (>2%), T. vulgaris showed the lowest MIC at 0.05%. Ketoconazole had a MIC of less than 0.03 μ g/ml. The MIC at 50% concentration was demonstrated by EO combinations 1 (0.5 % C. paradisi, 0.5 % S. sclarea, 0.5 % O. basilicum, and 1% R. officinalis) and 3 (1% S. sclarea, 1% R. officinalis, and 1% L. hybrida). Fungal growth was reduced at a 75% dilution by combinations 4 (1% C. limon, 0.5% R. officinalis, 1% C. paradisi, and 0.5% Anthemis nobilis (A. nobilis)) and 5 (1% A. nobilis, 0.5% C. paradisi, 0.5% T. vulgaris, and 1% L. hybrida 1%).At a 25% concentration, the MIC for Mixture 2 (1% C. limon, 0.5% S. sclarea, 1% R. officinalis, and 0.5% A. nobilis) was demonstrated. Even at sub-MIC concentrations, the synergistic activity of EOs produced noteworthy outcomes in in vivo investigations. In vivo tests revealed that Mixture 2 performed better whereas Mixture 5 produced negligible results. When given combination 4, several dogs experienced negative side effects, such as swelling erythema [112]. The combined effects of oregano essential oil and yeast cell wall on dogs' digestion, taste preferences, intestinal fermentation byproducts, and gut microbiota were examined in a recent study. When compared to the control diet, the dogs' apparent total tract digestibility of dry matter and intake ratio dropped when this blend was added to their diet. Additionally, it had a positive impact on the fecal matter's beneficial microbes, leading to increased [113].

In dogs kept in a rescue shelter, Graham et al. [114] documented the olfactory stimulating qualities of essential oils (EOs) such as peppermint, lavender, chamomile, and rosemary. For five days, the dogs were exposed to each olfactory stimulant for four hours each day, with a two-day gap between each exposure, thanks to the diffusion of EOs. The study found that, despite the absence of obvious symptoms of olfactory habituation, extended exposure to EOs had a discernible impact on the behavior of the dogs. It's interesting to note that the shielded dogs were more active when exposed to stimulating scents like peppermint and rosemary essential oils. However, even though all scents were introduced for the same amount of time, stress-reducing odorants (such as lavender and chamomile essential oils) did not have the same effect. Notably, the dogs did not become accustomed to any scents, including chamomile and lavender, which are known to reduce tension. Still unknown, though, was the potential for eventual habituation with continued exposure. According to the study, the new smells were probably more responsible for the observed behavioral alterations than other environmental factors. The results emphasized the significance of choosing scents wisely because adding fragrances that make people agitated or stressed out could have negative consequences. It was mentioned that dogs who are already acting hyperactively or in an unusual way would not benefit from fragrant stimulation. On the other hand, relaxing aromas may help dogs feel better [114]. The skin lesions and itching linked to canine atopic dermatitis (CAD) are affected by a topical preparation that contains EOs and polyunsaturated fatty acids (PUFAs). Once a week, the dogs received a test formula or a placebo applied to the upper neck region. Prior to and following the trial, veterinarians and owners evaluated the degree and severity of CAD using the Canine Atopic Dermatitis Extent and Severity Index-03 (CADESI-03) and pruritus scores. The treatment group's CADESI-03 and pruritus scores significantly improved as compared to the placebo group, according to the data.



In addition, compared to the placebo group, more dogs in the therapy group showed at least a 50% improvement in their CADESI-03 and pruritus scores. A safe and effective method of treating the clinical symptoms of CAD was the topical solution that contained PUFAs and EOs [115].

A dental cleaning and examination, including a periodontal assessment comprising probing and assessments of plaque, calculus, and gingivitis, was performed on dogs as part of a blinded crossover clinical experiment. The soft tissues inside their canines' lips were then treated twice a day for four weeks with a gel (either active or a placebo). Following another cleaning of the dogs' teeth, the owners continued to use the substitute gel for four more weeks. After the first cleaning, as well as during the fourth and eighth weeks, clinicians assessed poor breath, and owners gave weekly bad breath scores. Bad breath decreased in the group that switched from placebo to active gel during the placebo application and continued to decrease during the active gel application. When utilizing the active gel, seven out of nine owners reported having less foul breath.

Dogs' oral bad breath was lessened by applying a topical gel that contained menthol, thymol essential oil, and polyphenolic antioxidants (ferulic acid and chloretin) [116]. The goal of Goode et al. [117] was to evaluate how different essential oils (EOs) or active compounds in commercially available repellents affected the attachment of Ixodes ricinus (ticks) to dogs. Compared to other EOs, turmeric EO had a longer residual action and inhibited a tick's climbing response. Tick attachment on blankets treated with turmeric EO, orange EO, N, N-Diethyl-3-methylbenzamide (positive control), or 1% coco glucoside excipient solution (negative control) was evaluated in a following blanket dragging field assay. Based on 899 tick counts, the results indicated that the negative control, orange EO treatment, turmeric EO treatment, and positive control groups had an average of 23.3 ± 21.3 , 26.9 ± 28.6 , 2.6 ± 2.0 , and 3.4 ± 3.7 ticks per blanket, respectively. Dogs sprayed with 2.5% orange EO (n = 16) and 2.5% turmeric EO (n = 24) were permitted to walk in known tick-infested areas, but the control group (n = 15) was not. Compared to dogs sprayed with orange EO and control dogs, dogs sprayed with turmeric EO had a noticeably decreased percentage of ticks adhered to their legs or abdomen. These results imply that using turmeric essential oil in a domestic dog tick management program may be beneficial. [117]

A microemulsion formulation comprising thymol and eugenol was created in an effort to safely and effectively manage Rhipicephalus sanguineus Sensu Lato (R. sanguineus), also known as the brown dog tick, in dogs. Its physical properties and safety were evaluated. Microemulsions exhibit a high degree of physical stability. The quantity of larvae infesting the canines on the first day significantly decreased after treatment with microemulsion, while the number of nymphs and adults did not significantly decrease. Larval hatchability was significantly impacted by the reproductive biology of engorged females, yielding an outstanding control rate of 85.5%. In summary, microemulsion influences the reproductive characteristics of engorged female brown dog ticks and successfully lowers the number of larvae. Additionally, it keeps its physical stability for two years and is safe for dogs [118].The effects of the dog feed enhanced with natural antioxidants (a combination of essential oils and vitamin E) on food preservation and canine health were evaluated. Oxidative stress was mitigated in the experimental group that received the natural antioxidant diet, as evidenced by a significant drop in ROS levels.

Additionally, a rise in non-protein thiol and glutathione S-transferase levels was observed, which may help to explain the observed drop in ROS levels.



It was concluded that adding natural antioxidants to dog feed improves food preservation and raises systemic antioxidant levels, thereby reducing the negative effects that free radicals cause in dogs [119].

Fourteen cats with symptoms of spontaneous dermatophytosis brought on by M. canis were the subjects of a study. Cats in group 1 received itraconazole orally for one week at a dose of 5 mg/kg/day for a minimum of six weeks of treatment. Washing was done twice a week using neutral shampoo and roughly 5 mL of EOs from Thymus serpyllum (T. serpyllum) (2%), O. vulgare (5%), and R. officinalis (5%). Cats in group 2 were treated twice a week with 2% miconazole/2% chlorhexidine shampoo and the same oral itraconazole dosage. Two cats in group 1 were clinically healthy by week three following therapy, and by week eleven, all other cats were as well. All of the cats in this group had negative fungal culture results at the end of the study. At the end of the experiment, every cat in this group had a negative fungal culture test. Group 1 cats took an average of 6 weeks (median 4 weeks, range 3-11 weeks) to achieve clinical cure, and 15 weeks (median 14 weeks, range 7-42 weeks) to achieve mycological cure. One cat in group 2 had a normal dermatology by week three, and by week ten, all of the cats had a clinical cure. By the time the trial ended, six of the seven cats in this group had negative fungal culture results. Group 2 cats had a mean time to clinical cure of 5.9 weeks (median 6 weeks, range 3-10 weeks) and a mycological cure of 12.8 weeks (median 6 weeks, range 7-21 weeks). According to the study, shampoo comprising essential oils of T. serpyllum, O. vulgare, and R. officinalis may serve as a substitute for traditional cat dermal care [120].Eleven clinical isolates of M. canis were used to test the antifungal effectiveness of essential oils (EOs) extracted from C. limon, T. serpillum, R. officinalis, O. vulgare, and Illicum verum (I. verum). T. serpillum and O. vulgare had the lowest MICs among the studied EOs, followed by I. verum, R. officinalis, and C. limon. When compared to the individual components, a prepared mixture of 5% O. vulgare, 5% R. officinalis, and 2% T. serpillum in sweet almond oil showed improved antimycotic action. This cocktail was then administered to seven cats with symptoms of M. canis infection. Four out of the seven cats that received treatment showed clinical and cultural recovery, demonstrating the strong antifungal properties of T. serpillum and O. vulgare essential oils [121].

150 cats were subjected to three different olfactory conditions: ecologically relevant fragrances (rabbit scent, or prey scent), biologically non-related odors (catnip and lavender scents), and control (no smell). For five days in a row, the cats were exposed to the smells for three hours each day. On days one, three, and five, cat behaviors were recorded every five minutes. The cats spent just over 6% of the observation period displaying little interest in scented clothing. Specifically, cats who were exposed to cloths scented with catnip showed noticeably greater attention, occupying an average of 11.14% of the observation period. Interest in clothing declined in the second and third hours under all settings, suggesting habituation. Some aspects of the cats' behavior were impacted by olfactory stimulus. Scents of prey and catnip both increased the frequency of decreased activity-related behaviors. The "catnip response" is a particular play-like behavior that was also elicited by catnip [122].O. vulgare EO (OEO) has been shown to have anti-toxic properties against aflatoxin B1 (AFB1). Four weeks of age was used to randomly assign 48 New Zealand White growing rabbits into four groups with four replicates each: the control group (basal diet only), the AFB1 group (0.3 mg AFB1/kg diet), the OEO group (1 g OEO/kg diet), and the co-exposed group (1 g OEO/kg + 0.3 mg AFB1/kg diet). The findings showed that OEO considerably decreased cystatin C levels, which in turn lessened the harmful effects of AFB1 on rabbit kidneys.



Furthermore, in the co-exposed group, OEO reduced lipid peroxidation and oxidative stress. OEO reduced inflammatory responses and DNA damage while downregulating genes that encode inflammatory cytokines and stress.Additionally, the cytoarchitecture of rabbit kidneys treated with AFB1 was retained by OEO [123].

EOs are mostly applied topically to prevent or lessen infestations and/or skin affections [124], although occasionally they are included to food supplements as a nutritional addition to the dog's regular diet. Because the essential oils are lipophilic, a fat matrix, like salmon oil, must be used for optimal EO solubilization. In this instance, the EOs enhance the antioxidant characteristics of salmon oil in addition to its advantageous attributes (richness in omega-3) and its inherent tocopherol and carotenoids. Immunological function is positively impacted by increasing consumption of specific functional elements, such as vitamin D, omega-3 PUFA, and phytogenic substances like some essential oils and tea catechins, which strengthen defenses and lower the risk of infection [125]. A variety of essential oils (EOs) with functional specificities, such as antiparasitic action with savory, sagebrush, and clove EOs or joint-articular enhancement with eucalyptus, ginger, and marjoram EOs, are included in one of these recently released products [126].

5 .POSSIBILITIES AND LIMITATIONS OF THE USE OF ESSENTIAL OILS IN DOGS

5.1 LACK OF SCIENTIFIC VALIDATION

One of the limitations of essential oil use in dogs, cats, and other animals is the uncertainty regarding a number of factors related to its application. This is partly due to the fact that there is still a lack of investigation and scientific validation of their effects. Many times, the efficacy of essential oils is based on anecdotal evidence and different practical approaches, which is undoubtedly insufficient for general use and may be harmful to animals. Additionally, it was evident that many studies dealt with in vitro efficacy testing. When opposed to field tests, laboratory tests undoubtedly offer a number of benefits, including simplicity, speed of results, and reduced costs. They are most helpful for the preliminary assessment of novel active ingredients and the identification of those that have the most promise for additional research [127]. Still, validation of a substance's efficacy following application to animals is necessary to provide a comprehensive picture of its potential use.

5.2 NATURE OF OIL

A further barrier to the broader application of essential oils is the volatility of several of their constituents. Because essential oils include a large number of volatile and lipophilic molecules, they are susceptible to conversion and degradation processes. As a result, essential oils lose their pharmacological qualities and their active components become inactive [128]. Practically speaking, this means that the active elements in essential oils may not reach the target sites of action or may only reach them partially. In certain situations, essential oils are rapidly inactivated after administration. Although the same oils have demonstrated excellent activity in vitro, numerous investigations of the oral use of essential oils in farm animals have demonstrated this impact against endoparasites in the distal portions of the digestive tract [129]. The majority of this research, meanwhile, focused on ruminant applications; it is unclear whether and to what degree these findings apply to dogs and cats.



Additionally, as demonstrated in the aforementioned study on ticks in dogs, the instability of essential oils most likely has no effect on its antiectoparasitic application because some formulations are applied directly to the skin [130].

5.3 SAFETY CONCERN

The main obstacle to the broader usage of essential oils at the moment is their safety, which has not been thoroughly evaluated. Since most essential oils are regarded as "generally safe" to use in human medicine, there are over 300 distinct essential oils available on the market that are effectively employed for a variety of reasons, and intoxication instances are quite uncommon [131]. Some essential oils are regarded as hazardous or possibly toxic for pets, while the majority of this information is derived from unofficial sources. Cinnamon, mint, Mentha pulegium, tea tree oil, pine oil, oils from some citrus plants, sweet birch (Betula lenta), canaga (Cananga odorata), eucalyptus, lavender, evergreen oil, and occasionally oregano are some of the essential oils that are most frequently referenced in this context. Dogs and cats topically treated with high dosages of tea tree essential oil for dermatological conditions have been reported to experience a clinical episode of intoxication with symptoms of weakness, incoordination, and muscle tremor; nonetheless, the animals recovered following supportive medication [132]. In a another instance, three Angora cats had intoxication with signs of hypothermia, incoordination, thirst, shivering, etc. after 20 milliliters of tea tree oil were administered topically to their skin. Two animals recovered in 24 to 48 hours following supportive care, but one passed away [133]. There is relatively little information available about other essential oils.Certain aspects of the metabolism of dogs and cats may be the source of some essential oils' possible toxicity. Specifically, UDPglucuronosyltransferase enzymes, including UGT1A6 and UGT1A9, which are critical for glutaronidation activities, are known to be deficient in cats [134]. Thus, active ingredients that undergo biotransformation and are subsequently removed in this manner may build up within the body and result in toxic symptoms. This also holds true for some medications like aspirin, propofol, carprofen, and paracetamol. Essential oils that contain phenolic compounds should be avoided or handled very carefully around cats because of the way they are metabolized, which can also result in poisoning symptoms. Although cats are often thought to be more susceptible to drug metabolism than dogs, dogs' metabolism also has unique characteristics, such as a lack in the N-acetyltransferase enzyme [135]. Regardless, any medication can be harmful if taken improperly, and this also applies to essential oils, which differ greatly from one another. Essential oils can be used effectively and safely if the right plant species are chosen and used appropriately in terms of dosage, concentration, and application technique. Encapsulating essential oils before administering them to pets is one way to address this problem.Encapsulation slows down the rate of evaporation and lessens the interaction of active ingredients with other substances. This could improve the bioavailability of essential oils (such as their antibacterial and antiendoparasitic properties) and lessen the inactivation of their active components in animals. Additionally, given that various applications frequently call for enhanced retention of active ingredients as well as ease and accuracy in handling active substances and varying release profiles (such as antiectoparasitic application), this technique permits controlled release of the active substance, which is crucial. Encapsulating essential oils also lessens their potent smell, which is important because dogs and cats have very acute senses of smell. [136,137]

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6. Conclusion

Essential oils are recognized to have a variety of uses for both cats and dogs, exhibiting a number of advantageous qualities that can support their general health and welfare. These oils are helpful in fighting off harmful microbes since they have antibacterial and antifungal properties. Essential oils have demonstrated effectiveness against many endoparasite and ectoparasite species assisting in preventing illnesses and infestations in dogs. Oregano, with its strong antimicrobial properties; thyme, with its rich phytochemical profile; cinnamon, with its warming effects; mint, with its refreshing aroma; basil, with its anti-inflammatory benefits; lemon balm, with its calming properties; mountain savory, with its strong antibacterial action; eucalyptus, with its respiratory support; lavender, with its calming scent; rosemary, with its cognitively enhancing properties; are some of the essential oils and their active ingredients that are frequently studied. The use of essential oils has some restrictions, much like any medication, mainly because there aren't enough scientific studies to support its efficacy and safety. But as phytotherapy gains popularity in animal healthcare, more scientific studies are being conducted, opening the door to the potential of choosing the best essential oils or formulations based on them for sensible application in daily practice. Additionally, the encapsulation technology provides a way to increase in vivo efficacy and safety while overcoming numerous obstacles to the use of essential oils in dogs and cats.

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THE INFLUENCE OF CLIMATE FACTORS ON THE PREVALENCE OF TICKS OF SMALL RUMINANTS IN SPREAD BELGRADE AREA

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Abstract

During last decades on Belgrade area were increased. semi-intensive breeding of sheep in village at spread Belgrade area. Way of breeding had prerequisite to a lot of infections including ticks. Tick infestations are common, especially during late spring and autumn months of the year.

In our paper we present the results of research conducted in the period 2020-2022 years. During our examination we examined 53 heards of sheep originated from 23 villages from 6 city districts. In total we examined 237 animals. Ticks were collected monthly during the period from the exit to the pasture to the retreat to the barn (March to October). The tick species and sex/gender were identified by morphometric characteristics.

Ticks infestation we occured at 50.26% sheep. The most abudant species was *Ixodes ricinus* (43.11%), followed by *Dermacentor marginatus* (28.21%), *Rhipicephalus bursa* (12.22%), *R.sanguineus* (11.72%), *Haemaphysalis punctata* (4.21%) and *D.pictus* (1.12%). The sex ratio showed a higher number of females in four species (*I.ricinus, H.punctata, R. sanguineus* and *D.marginatus*), while higher number of males were detected in *R.bursa* and an equal number of the *D.pictus*. The population dynamics of recorded tick species showed two annual maxima, in spring and in autumn. In April population maximum we established for *D.marginatus, D.recticulatus* and *H.punctata* and in May for *I.ricinus*. The autumn population peak in September and in October occurred for the *I.ricinus, D.marginatus* and *H.punctata*.

These findings are of great epidemiological importance because these types of ticks transmit a multitude zoonotises like *Borellia burgdefori*, *Erlicihia spp., Anaplasma spp. and etc.* **Keywords:** tick, small ruminant, Belgrade area



SUSTAINABLE BIOPLASTICS PRODUCTION FROM FISH WASTE: THEIR EXTRACTION AND APPLICATIONS

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Abstract

Fish waste is becoming increasingly popular as an alternate origin of raw materials used for the production of sustainable bioplastics, with major economic and environmental benefits in various application areas, including food packaging and medicine. The problems with fish waste and the possibility of recycling these by-products utilizing a circular economy approach have been fully explained. The latest innovations in the production of bioplastics from fish waste are discussed in this comprehensive review. The bioplastic industry encourages eco-friendly ways to reduce pollution, plastic waste, and the use of fossil fuels. This review article summarizes that waste recycling has led to the evaluation of innovative products by chemical or biological techniques rather than releasing these waste products into the environment. As a result, recycling waste makes it more cost-effective, environmentally beneficial, and healthful. Also, it uses bioplastics rather than plastic, lowering the use of petroleum-derived products.

Keywords: Fish waste, Sustainable Bioplastics, Innovative Products

COMPARATIVE ANALYSIS OF CONVENTIONAL PLASTIC AND BIOPLASTIC ON ENVIRONMENTAL AND ECONOMICAL ASPECT THROUGH TECHNO ECONOMICAL ANALYSIS & LIFE CYCLE ASSESSMENT

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Abstract

Plastic production, consumption, and deposition are growing exponentially, and currently, only 9% of the world's plastics are recycled. The insufficient rate of recycling contributes to the accumulation of plastic waste in landfills and ecosystems, resulting in detrimental ecological consequences. Microplastic particles, which are formed through the degradation of larger plastic items, have been detected in various environmental settings. Addressing this global challenge necessitates the implementation of enhanced waste management practices, increased public awareness initiatives, and the development of sustainable alternatives to conventional plastics. 91% of plastic waste is either dumped in landfills or the ocean or burned, where it eventually finds its way into the human body through the food chain. Life cycle assessment is a crucial tool for assessing a product's sustainability, which remains poorly understood. This study aims to assess the environmental impact associated with the production of both plastics through life cycle assessment (LCA) and techno-economic analysis. LCA involves a cradle-to-gate approach through input-output data, which includes all energy emissions (fuels, electricity), resource consumption (water, chemicals, and materials), and the costs of each process. The analysis considered the potential for global warming, fossil energy consumption, acidification, eutrophication, and human health hazards associated with both plastics. Techno-economic analysis is required to identify the costbenefit ratio to make the product cost-effective. An economical and environmentally sustainable strategy is essential to increase the viability of bioplastics and reduce reliance on plastics derived from fossil fuels. The results of this study can provide valuable insights into the environmental impacts and economic feasibility of both conventional plastics and bioplastics. By comparing the life cycle assessments and techno-economic analyses of these materials, policymakers and industry leaders can make informed decisions about sustainable plastic production and consumption. Furthermore, this research may help identify areas for improvement in the bioplastics production process, potentially leading to more cost-effective and environmentally friendly alternatives to conventional plastics.

Keywords: Life Cycle Assessment, Bioplastic, Techno economical Analysis



UNVEILING FLAXSEED'S BIOACTIVE COMPONENTS FOR EMERGING THERAPEUTIC INNOVATIONS

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ABSTRACT

Flaxseed, often known as linseed belongs to the Linaceae family has emerged as the main focus of nutrition and medical studies because of the potential for bioactivity of flaxseeds. The components of flaxseed oil vary depending on the seed variety, location, ambient conditions and examination techniques. A variety of physiologically active substances, such as lignans, omega-3 fatty acids, soluble dietary fiber and peptides are produced by the flax plant. Flaxseed is considered the most significant functional dietary product, based on a number of research. The addition of flaxseed to food items helps create sustainable and healthy dietary choices. Because of its distinct chemical structure, flaxseed oil is widely known for its health advantages and is one of the best plant-based sources of PUFA omega-3 fatty acids. Additionally, flaxseed improves gut flora health and has prebiotic qualities. Significant levels of bioactive components increase flaxseed's medical, pharmacological, and commercial usage Flaxseed is a desirable option for people looking to enhance their general well-being because of these health advantages. Studies conducted recently have demonstrated the anti-cancer potential of flaxseed proteins. These characteristics are explained by their capability to stop the growth of cancer cells, trigger apoptosis and disrupt the signaling pathways of cancer cells, which in turn prevents metastases. The addition of flaxseed to meals can be simple and enhance your intake of nutrients, regardless of whether you choose to use entire seeds, ground seeds or flaxseed oil. Several studies have limited down the broad variety of uses for flaxseed.

Keywords: Flaxseeds, Omega-3 fatty acids, Functional food, Health benefits



FOURIER TRANSFORM INFRARED (FTIR) SPECTROSCOPIC ANALYSIS OF ESSENTIAL OILS FROM THE *LAMIACEAE* FAMILY

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Abstract

Introduction

Essential oils play a significant role in the industry and aromatherapy, being widely used in both traditional medicine and holistic healing practices. Their growing popularity increases the risk of adulteration and the addition of low-quality substitutes. Gas chromatography (GC) is the primary analytical method for essential oil characterization. However, Fourier transform infrared (FTIR) spectroscopy has emerged as a fast and reliable alternative requiring minimal sample preparation.

Aim

This study aims to analyze the FTIR spectra of essential oils from the Lamiaceae family.

Materials and Methods

Three essential oil samples from *Origanum vulgare*, *Thymus vulgaris*, and *Lavandula angustifolia*, sourced from different manufacturers, were analyzed. FTIR spectra were recorded in the mid-infrared region using a Bruker Tensor II spectrometer.

Results

The spectral bands correspond to the key components of the essential oils. Oregano and thyme oils contain similar compounds, including carvacrol, thymol, cymene, and myrcene, resulting in nearly identical spectral profiles. Lavender oil, with a composition dominated by linalool and linally acetate, exhibits distinct vibrational signals.



Conclusion

ATR-FTIR spectroscopy is an effective technique for the identification and comparison of essential oils. The characteristic spectral bands serve as a "spectral fingerprint" of the major constituents, aiding in authentication and quality assessment.

Keywords: FTIR Spectroscopy, essential oils, Lamiaceae, analysis.



THE INVESTIGATION OF THE EFFECTS OF PBS LOADING LEVEL ON THE MECHANICAL AND RHEOLOGICAL PROPERTIES OF TPU

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ABSTRACT

This study focuses on the incorporation of an optimal ratio of poly(butylene succinate) (PBS) into an ether-based thermoplastic polyurethane (TPU) matrix. TPUs are widely used in various applications due to their excellent properties, including high abrasion resistance, flexibility over a wide temperature range, superior elasticity across all hardness levels, and exceptional resistance to oils, greases, and solvents. However, their non-degradability in nature limits their use in safety-critical environments. To address these limitations, biodegradable PBS was added to improve the environmental degradability of TPU without compromising its flexibility. The loading level of PBS on the mechanical, rhelogical and thermal properties of ether-based thermoplastic polyurethane was determined. Moreover, possible interaciton between the components was investigated via Fourier transform infrared spectroscopy (FTIR) analyses. The PBS concentration was evaluted as 10-50 wt%. The TPU/PBS blends were prepared through melt compounding using a high-torque twin-screw Xplore model micro-compounder, followed by injection molding to obtain standard test samples. It was observed that the properties of the TPU/PBS blends varied in accordance with the PBS loading ratios, and values close to the desired targets were achieved. The findings of this study demonstrated that it is possible to enhance the biodegradability of TPU without compromising their mechanical properties or processability.

Keywords: TPU, PBS, mechanical properties, rheological properties



THE ROLE OF MICROBIOMES IN HUMAN HEALTH AND DISEASES

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Abstract

The human gut microbiome is a complex and dynamic ecosystem that harbors trillions of microorganisms, including bacteria, viruses, archaea, phages, fungi, and unicellular eukaryotes. This diverse microbial community plays a crucial role in maintaining human health by influencing various physiological functions. Among these microorganisms, bacteria are particularly significant as they provide essential genes and enzymes that facilitate the metabolism of both dietary and host-produced compounds. This interaction creates a symbiotic relationship between the external environment and the human body, impacting functions at both local and systemic levels.

The gut microbiome is primarily composed of commensal bacteria, which are essential for maintaining a healthy immune system, aiding digestion, and synthesizing vital nutrients such as vitamins and amino acids. These bacteria also play a protective role against harmful pathogens and contribute to key physiological functions, including the regulation of endocrine, neural, and immune systems. Furthermore, the gut microbiome influences metabolic pathways, affecting overall well-being and health outcomes. For instance, the production of short-chain fatty acids (SCFAs) from the fermentation of dietary fibers by gut bacteria is crucial for energy homeostasis and gut health, highlighting the microbiome's role in nutrient metabolism.

However, changes in the gut microbiome—whether qualitative, quantitative, or topographic—can disrupt this delicate balance and lead to a condition known as dysbiosis. This imbalance has been linked to various noncommunicable diseases, including hypertension, cardiovascular disease, obesity, diabetes, inflammatory bowel disease, irritable bowel syndrome, and even certain cancers. Dysbiosis can weaken the gut barrier, resulting in increased intestinal permeability, often referred to as "leaky gut." This condition can trigger systemic inflammation and immune dysfunction, further exacerbating health issues.

While much of the existing research on the gut microbiome is observational and does not establish direct causation, ongoing clinical studies and advanced genomic techniques are providing deeper insights into these complex relationships.



For example, recent findings have identified specific microbial signatures associated with metabolic disorders and inflammatory conditions, underscoring the importance of understanding these associations for developing targeted interventions. Emerging strategies for microbiome engineering, such as probiotics, prebiotics, fecal microbiota transplantation, and dietary modifications, offer promising therapeutic potential. These interventions aim to restore microbial balance and improve health outcomes, paving the way for novel treatments for various diseases.

In conclusion, the gut microbiome is a vital component of human health, influencing metabolic, immune, and physiological functions. Understanding the intricate relationships between gut microbes and health can lead to innovative therapeutic strategies for managing various diseases. As research progresses, the potential for microbiome-based interventions to enhance health and prevent disease becomes increasingly evident.

Keywords: Microbiome, Gut barrier, Gut microbes, Intestinal permeability, Leaky gut, Dysbiosis, Probiotics.



GEOBOTANICAL DATA ON FLORA AND VEGETATION IN SOME AREAS OF ELBASAN

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Abstract

The Elbasan region, located in central Albania, is characterized by a rich diversity of flora and vegetation, shaped by the interaction of Mediterranean and continental climatic conditions, as well as a varied geological and topographical landscape. However, human activities such as natural resource exploitation and urban development can impact the area's natural habitats and biodiversity. It is essential to implement measures to minimize these negative effects and maintain the ecological balance of the region.

This study aims to present geobotanical data on the flora and vegetation of selected areas in Elbasan. The research focuses on key strategic zones, including Byshek, Qafë-Kërrabë, Ullishtë, Krastë, Xibrakë-Lugina e Shkumbini, and Elbasan, where field expeditions were conducted. Based on the collected data, floristic spectra were constructed to analyze life forms, floristic elements, and the percentage distribution of plant families in the region.

The findings indicate that the most widespread biological forms are Hemicryptophytes, Phanerophytes, and Therophytes. Regarding floristic elements, the dominant types include Eurymediterranean, Eury-Southeast, Central European, and Eurasian species. The most abundant plant families are *Fabaceae, Poaceae, Asteraceae*, and *Labiatae*.



Additionally, a significant number of medicinal plants were identified, primarily from the *Asteraceae, Labiatae, Rosaceae*, and *Fabaceae* families. **Keywords:** biological forms, floristic diversity, flora, medicinal plants,



EXTRACTION AND PHYSICOCHEMICAL CHARACTERIZATION ANALYSIS OF EMILIA SONCHIFOLIA

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Abstract

Emilia Sonchifolia potential bioactive properties have been assessed by physiochemical analysis and extraction. Petroleum ether, chloroform, ethyl acetate, methanol and aqueous solvents with increasing polarity were used in series of solvent extractions. After each extraction, which extended 16 hours with occasional shanking, the extracts were concentrated using a rotary evaporator. Several physiochemical characteristics were examined in order to ensure the plant materials quality and purity. Total ash and solvent soluble ash values were tested to determine the presence of inorganic materials and contaminants, while drying loss was calculated to evaluate moisture content and volatile components. These characteristics are crucial quality control measurement for herbal formulations and additionally provide information on the stability and makeup of the crude medicine. The findings of the present investigation help to standardize extracts of *Emilia Sonchifolia*, which makes it easier to carry out more pharmacological and phytochemical research for potential medicinal uses.

Keywords: Emilia Sonchifolia, Solvent extraction, Physiochemical analysis, Ash value

DESIGN NOVEL, POTENT AND SELECTIVE SURVIVIN INHIBITORS BASED ON THE MX-106 HYDROXYQUINOLINE SCAFFOLD, USING 2D-QSAR MODELING, MOLECULAR DOCKING, MOLECULAR DYNAMICS AND ADMET PROPERTY ANALYSIS

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Abstract

The urgent need for the development and discovery of new inhibitors targeting survivin (BIRC5), recognized as one of the most tightly regulated genes in tumor cells, underscores the current research focus. Survivin serves as a specific cancer biomarker and represents a promising target for anticancer medications. This study outlines the design methodology employed for crafting a series of novel and selective survivin inhibitors, drawing inspiration from the hydroxyquinoline framework of our previously documented lead compound, MX-106.

Our investigation identifies nine compounds projected to demonstrate heightened inhibitory potential compared to the most potent member within the studied set. In vitro assays confirmed the effectiveness of these compounds in impeding the proliferation of MDA-MB-435 breast cancer cells. Furthermore, the metabolic stability of these compounds surpassed that of the most active molecule within the test set.

Employing 2D-QSAR methods encompassing multiple linear regression (MLR), multiple nonlinear regression (MNR), and artificial neural networks (ANN), alongside molecular dynamics, molecular docking, and ADMET properties evaluation, we assessed the viability of 31 hydroxyquinoline scaffold derivatives of MX-106 as selective survivin inhibitors. Molecular docking simulations were conducted to gauge the stability of compound C24, revealing the establishment of multiple hydrogen bonds with diverse residues. A subsequent 100-ns molecular dynamics simulation affirmed its sustained stability over the entire duration, indicating their potential suitability for further drug development endeavors.

Building upon the insights garnered from molecular modeling outcomes, we devised nine innovative compounds (Pred1, Pred2, Pred3, Pred4, Pred5, Pred6, Pred7, Pred8, and Pred9), anticipated by MLR models to exhibit potent survivin inhibitory activity. We advocate for a comprehensive evaluation of the ADMET properties of these newly proposed compounds, positioning them as promising candidates for pioneering anticancer agents targeting survivin inhibition akin to MX-106.

Keywords: QSAR, tumor cells, Molecular Docking, Molecular dynamic, ADMET properties, selective survivin inhibitors, cancer, MX-106 hydroxyquinoline scaffold.



COMPARATIVE ASSESSMENT OF THE ANTIMICROBIAL ACTIVITY OF JUNIPERUS OXYCEDRUS EXTRACTS AGAINST PATHOGENIC MICROORGANISMS

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Abstract

Juniperus oxycedrus, commonly known as the prickly juniper, is a thermophilic shrub or small tree native to the Mediterranean region, extending from Morocco and Portugal to Lebanon and Syria. The prickly juniper is not only valued for its ecological role but also for its economic uses. The wood is durable and used in construction and carpentry, while essential oils extracted from the plant have medicinal properties, particularly for treating skin conditions like dermatitis. The extract of twigs or leaves is rich in polyphenols, which contribute to their antibacterial and antifungal activities.

This study investigates the antibacterial properties of various plant extracts against common bacterial pathogens, focusing on their potential as natural antimicrobial agents. The research involved evaluating the efficacy of extracts from *Juniperus oxycedrus* plant against both Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus*, *Escherichia coli*, and *klebsiella*. Using methods like agar well diffusion and broth microdilution, the minimum inhibitory concentrations (MIC) and minimum bactericidal concentrations (MBC) were determined. The results indicated that methanolic extracts exhibited significant antibacterial activity. These findings underscore the potential of using plant-derived compounds as effective alternatives to conventional antibiotics, particularly in addressing antibiotic-resistant strains. The results advocate for further research into the application of these extracts in food preservation and medicinal contexts, emphasizing their role in enhancing food safety and public health.

Keywords: Juniperus oxycedrus, antimicrobial activity, extract, MIC, MBC.



POLLUTION, MIGRATION, AND INTERNATIONAL POLICIES: MANAGING HEAVY METAL AND RADIOACTIVE CONTAMINATION IN A GLOBALIZED WORLD

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Abstract

Industrial activities, mining, and nuclear operations have led to severe environmental contamination, particularly from heavy metals and radioactive pollutants. This pollution poses a significant threat to ecosystems and human health, disproportionately affecting vulnerable populations, including migrants forced to leave contaminated areas. Addressing these challenges requires coordinated international policies that integrate scientific innovation with global governance.

Despite advancements in pollution control technologies, regulatory gaps persist in addressing pollution-induced displacement and enforcing cross-border environmental policies. The lack of stringent international cooperation exacerbates environmental injustices, leaving affected communities without adequate protection or remediation strategies. While scientific innovations offer promising solutions for wastewater treatment and decontamination, their impact remains limited without effective policy integration.

This study underscores the urgent need for a multidimensional approach that bridges scientific research with international governance. Strengthening legal frameworks, enhancing global cooperation, and promoting sustainable technologies are essential steps toward mitigating pollution, safeguarding vulnerable populations, and preventing forced migration due to environmental degradation.



Only through collective action can we develop long-term strategies to address the complex intersection of pollution, migration, and international policy.

Keywords: Polution; Migration; Governance; Security; Policy; Heavy metals; Radioactive



CUTTING-EDGE MATERIALS FOR HEALTH, WELL-BEING, THE ENVIRONMENT, AND SUSTAINABLE DEVELOPMENT

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Abstract

Exploring the transformative potential of cellulose-based adsorbent materials in industrial wastewater treatment, this research highlights their structural and textural properties for efficient pollutant adsorption. From the removal of heavy metals to organic compounds and dyes, these materials offer a sustainable solution, meeting regulatory standards while safeguarding human health and aquatic ecosystems. Delving into the mysteries of adsorption, this study underscores the critical role of these new materials in addressing water pollution challenges, emphasizing its economic viability and environmental friendliness. **Keywords:** adsorbent materials, polluants, treatment, industrial wastewater

PRODUCTION, CHARACTERIZATION AND PERFORMANCE OF GREEN GEOPOLYMER MODIFIED WITH INDUSTRIAL WASTE

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Abstract:

Discharges of various micropollutants (organic and inorganic) into the environment are on the increase. These pollutants are generally toxic, poorly biodegradable, and cause numerous adverse health effects. In this context, this work focuses on the development of a geopolymer based on red clay waste, with a view to its application as an adsorbent in the treatment of an aqueous medium contaminated by Methyl Orange. The synthesized geopolymer was characterized by various analytical techniques. The raw material and the synthesized geopolymers were characterized by various physico-chemical methods. The results of XRF, XRD, and FTIR confirmed the successful synthesis of geopolymer beads, while the SEM/EDX findings revealed the homogeneous surface of the adsorbents. Adsorption tests were carried out by varying various parameters likely to affect adsorption performance, including adsorbent dose, solution pH, contact time, initial Methyl Orange concentration, and solution temperature. The kinetic study revealed that the geopolymer eliminates Methyl Orange relatively quickly. The pseudo-second-order model is the most suitable for presenting the adsorption mechanism.



The isotherm for Methyl Orange retention on geopolymer is in perfect agreement with the Langmuir model. Evaluation of the thermodynamic quantities showed that the Methyl Orange adsorption process is favorable, spontaneous, and endothermic. The results we have found allow us to predict that the use of these new generations of geopolymers offers great potential for the retention of cationic textile dyes.

Keywords: Adsorption; red clay waste; Geopolymer Beads; Methyl Orange; Characterization.

B-CYCLODEXTRIN: ROLE IN DRUG DELIVERY OF ANTICANCER DRUG AND TOXICITY CONSIDERATION

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ABSTRACT

Cyclodextrins are distinguished by their hydrophobic inner surface. Chemical modifications are made to the three parent CDs (α -CD, β -CD, and γ -CD) principally to make them suitable for parenteral administration; they are then used in a wide variety of pharmaceutical applications. Inclusion complexes formed by β -CDs with a wide range of organic and inorganic lipophilic compounds provide unique benefits. Drug delivery, cancer therapy, gene delivery and biosensing are only few of the applications where this quality has shown promise. CDs have seen increased usage as functional materials for nanoparticle (NP) based medication delivery in recent years. Adding β -CDs and their derivatives to NPs is a useful way to alter their properties. Improved drug solubility is just one of the many advantages of β -CD conjugated NPs (β -CD-NPs), which also act as drug delivery carriers to specific sites, such as cancer cells, and thus reduce off-target toxicity. When compared to NPs, CDs fare better in terms of encapsulation efficiency with drug loading. The many applications of CDs in the field of nanoparticle-based drug carriers will be discussed in this overview. β -CDs effects on Inclusion complexes, polymeric NPs, magnetic and metallic NPs, and nanosponges are thoroughly investigated.

Keywords: Anti-Cancer Agent, Cyclodextrins, Target Drug Delivery, Nanotechnology, Therapy.

DEVELOPMENT AND EVALUATION OF DOXEPIN HYDROCHLORIDE-CHITOSAN MICROPARTICLES LOADED MUCOADHESIVE FILM FOR OROMUCOSAL DRUG DELIVERY IN CHEMO-RADIATION INDUCED ORAL MUCOSITIS

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Abstract

Oral mucositis is a debilitating complication of chemo-radiation therapy, significantly impacting patients' quality of life. This study aims to develop an oromucosal drug delivery system using doxepin hydrochloride (DOX)-chitosan microparticles loaded into a mucoadhesive film to provide sustained analgesic and anti-inflammatory effects. DOX, a tricyclic antidepressant with potent analgesic properties, was encapsulated in chitosan microparticles using an ionic gelation technique to enhance bioavailability and prolong drug release. The microparticles were then incorporated into a mucoadhesive film formulated with biocompatible polymers to ensure prolonged adhesion to the oral mucosa.Comprehensive physicochemical characterizations, including particle size analysis, zeta potential, entrapment efficiency, surface morphology, and thermal stability studies, confirmed the successful formulation of the microparticles and films. In vitro drug release studies demonstrated a sustained release profile, supporting prolonged therapeutic action. Mucoadhesion and mechanical strength evaluations indicated excellent film stability and adherence to mucosal surfaces. The developed system presents a promising strategy for effective pain management and symptomatic relief in oral mucositis patients. This novel approach offers an efficient alternative to conventional therapies by enhancing drug retention and bioavailability at the mucosal site, potentially improving patient compliance and treatment outcomes. Further in vivo studies will be conducted to validate its clinical efficacy.

Keywords: Oromucosal Drug Delivery, Doxepin Hydrochloride, Chitosan Microparticles, Mucoadhesive Film, Oral Mucositis, Chemo-Radiation Therapy

HEMATOLOGICAL ASSESSMENT THROUGH RANDOMIZED CBC TESTING IN ERBIL, KURDISTAN REGION OF IRAQ

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Abstract

This study investigates the variations in hematological parameters, including white blood cell (WBC) count, lymphocyte percentage (LYM%), granulocyte percentage (GRA%), and platelet indices, within a sample dataset. The WBC count ranged widely, with higher counts potentially indicating infection or inflammation, while lower counts suggested immune suppression or leukopenia. Lymphocyte percentages showed variability, with higher levels suggesting viral infections or lymphoproliferative disorders, and lower levels associated with stress responses or immune suppression. Granulocyte percentages also exhibited broad variation, with elevated levels linked to bacterial infections, stress, or chronic inflammation. Platelet count varied significantly, with high levels indicating thrombocytosis and low levels pointing to thrombocytopenia, which can be associated with various health conditions. Other platelet indices, including mean platelet volume (MPV), platelet distribution width (PDW), platelet large cell ratio (P-LCR), and platelet large cell count (P-LCC), displayed variations that could reflect platelet turnover, inflammation, or bone marrow disorders. Elevated MPV values typically indicate larger platelets, possibly signaling increased platelet activity or thrombocytopenia. PDW and P-LCR values also varied, suggesting altered platelet production or dysfunction. These variations highlight the need for further clinical investigation to understand the pathophysiology underlying these hematological changes. Monitoring these markers is crucial for diagnosing and managing various health conditions, such as infections, inflammation, and platelet-related disorders. The findings emphasize the importance of interpreting hematological data in conjunction with clinical evaluations for appropriate medical interventions.

Keywords: White Blood Cell Count, Lymphocyte Percentage, Granulocyte Percentage, Platelet Count, Mean Platelet Volume, Platelet Distribution Width, Platelet Large Cell Ratio, Immune Response.

MICROBIOTA MODULATION AS THERAPEUTIC APPROACH IN THE NEUROPATHIC PAIN IN DOG WITH SPINAL CORD INJURY: IMPACT OF POLENOPLASMIN

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Abstract

Background Studies have demonstrated the presence of gut dysbiosis (alterations in gut bacterial homeostasis) secondary to spinal cord injury in dogs. The dysbiosis is thought to impair recovery by decreasing the production of short-chain fatty acids which play a role in suppressing inflammation within the central nervous system.

Objective Therefore, targeting gut dysbiosis could have significant therapeutic value in the management of spinal cord injury. The purpose of this study is to determine if gut dysbiosis occurs in dogs with spinal cord injury. Another area of potential intervention interest is in situations of spinal injury where there is an urgent need to generate new neurons. To arrive at these observations, the authors examined how Polenoplasmin and diet solve paralysis in dogs.

Materials and methods The most common cause of spinal problems in dogs is trauma. We are currently assessing whether indoles can also stimulate formation of neurons in dogs with paralysis.

Results We found that gut microbes that metabolize tryptophan-an essential amino acidsecrete small molecules called indoles, which stimulate the development of new brain cells in dogs, also demonstrated that the indole-mediated signals elicit key regulatory factors known to be important for the formation of new neurons.

Conclusion This study is another intriguing piece of the puzzle highlighting the importance of lifestyle factors and diet. The link between the health of the microbiome and the health of the brain shows how microorganisms in the gut solve paralysis, gut microbe secreted molecule linked to formation of new nerve cells in paralyzed dogs.

Keywords: gut dysbiosis, indole, paralyzed dog, Polenoplasmin.

YENİ TAŞINABİLİR JİROSPUN İLE YARA İYİLEŞMESİ İÇİN PİEZOELEKTRİK/MÜR NANOFİBER İSKELELERİN BİYOKOMPOZİTİNİN ÜRETİMİ

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ÖZET

Piezoelektrik polimer nanofiberler, doku mühendisliği ve yara iyileştirme uygulamalarında hücre büyümesini ve çoğalmasını destekleme potansiyelleri nedeniyle son on yılda önemli ilgi görmüştür. Poli(viniliden florür-trifloro etilen) (P(VDF-TrFE)) iskeleleri, mekanik deformasyona maruz kaldığında elektrik yükleri üretme yeteneğine sahiptir. Bu yükler, cilt kusurlarını ve yaralı yara hücrelerini yenilemek için temel uyarıcılar olarak hizmet edebilir. Mür özütü olarak bilinen tıbbi bitki, öncelikle cesitli metabolitleriyle ilgili olan dikkate değer terapötik avantajları nedeniyle iyi bilinmektedir. Ek olarak, bakteriyel ve inflamatuar durumlara karşı umut verici bir etkiye sahiptir. Mevcut birçok tedavinin yaşam kalitesini olumsuz etkileyen önemli olumsuz etkileri olduğundan, uygulanabilir bir terapötik seçenek olma potansiyeline sahiptir. Güncel literatüre göre, Myrrh, botanik kaynaklardan elde edilmiş, analiz edilmiş ve hem tek başına hem de kombinasyon halinde doğal bir biyoaktif ajan olarak monoaksiyel gyrospun PVDF-TrFE nanofiber mimarilerine dahil edilmiştir. Lifler morfolojik, kimyasal, termal ve mekanik niteliklerini belirlemek için incelemeye tabi tutulmuştur. Üretilen pansuman yamalarının yüzey morfolojisi taramalı elektron mikroskobu (SEM) kullanılarak incelenmiştir. Ayrıca, lif üretim sürecinde kullanılan tüm bileşenler ile bu bileşenlerin kimyasal yapıları arasındaki etkileşimler Fourier dönüşümlü kızılötesi spektroskopisi (FTIR) kullanılarak incelenmiştir. Kompozit liflerin termal özellikleri Diferansiyel Taramalı Kalorimetri (DSC) kullanılarak analiz edilmistir. Avrıca, kompozit malzemelerin kristal özelliklerini karakterize etmek için X-ışını kırınımı XRD kullanılmıştır. Piezoelektrik katsayı ölçüm testi, polimerden kaynaklanan nanofiberlerin piezoelektrik özelliğini belirlemiştir. İlaç salım deneyleri, nanofiberden Myrrh salımını tespit etmiştir. Ek polimerik liflerin üretim verimi ve morfolojisi, polimer çözeltilerinin olarak. konsantrasyonları ve viskoziteleri gibi fiziksel özellikleri de dikkate alınarak, eğirme hızı, toplayıcı mesafesi ve püskürtme açıklığının çap boyutu gibi işleme parametrelerindeki değişim açısından incelenmiştir.



Gram pozitif ve Gram negatif bakterilere karşı oluşturulan ve test edilen biyohibrit nanofiberlerin antibakteriyel özelliklerini değerlendirmek için geleneksel disk difüzyon tekniği kullanıldı. PVDF-Trfe'nin piezoelektrik etkisi ve Myrrh'ın önemli antibakteriyel aktivitesi nedeniyle, hazırlanan biyohibrit nanofiberler doku mühendisliği ve yara iyileştirme uygulamalarında yeni yollar açacaktır.

Anahtar Kelimeler: Biyo-kompozit; Piezoelektrik; PVDF-TrFE; Mür; Nanofiber; Yara İyileşmesi, Gyrospun

FABRICATION OF BIO-COMPOSITE OF PIEZOELECTRIC/MYRRH NANOFIBER SCAFFOLDS FOR WOUND HEALING VIA NOVEL PORTABLE GYROSPUN

ABSTRACT

Piezoelectric polymer nanofibers have garnered significant attention in the last decade for their potential to promote cell growth and proliferation in tissue engineering and wound healing applications. Poly(vinylidene fluoride-trifluoro ethylene) (P(VDF-TrFE)) scaffolds have the ability to generate electrical charges when subjected to mechanical deformation. These charges may serve as essential stimuli for regenerating skin defects and injured wound cells. The medicinal plant known as Myrrh extract is well recognized for its notable therapeutic advantages, primarily related to its various metabolites. Additionally, it has promise efficacy against bacterial and inflammatory conditions. It has the potential to be a viable therapeutic option since many existing treatments have significant adverse effects that negatively impact one's quality of life. Concerning the current literature, Myrrh has been obtained from botanical sources, analyzed, and incorporated into monoaxial gyrospun PVDF-TrFE nanofiber architectures as a natural bioactive agent, both alone and in combination. The fibers have undergone investigation to determine their morphological, chemical, thermal, and mechanical qualities. The surface morphology of the produced dressing patches was examined using a scanning electron microscope (SEM). Moreover, the interactions between all the components used in the fiber manufacturing process and the chemical structures of these components have been studied using Fourier-transform infrared spectroscopy (FTIR). The composite fibers' thermal characteristics have been analyzed using Differential Scanning Calorimetry (DSC). In addition, X-ray diffraction XRD was used to characterize the crystalline properties of composite materials. The piezoelectric coefficient measurement test has determined the piezoelectric property of the nanofibers due to the polymer. Drug release experiments have detected the release of Myrrh from the nanofiber. Additionally, the production yield and the morphology of the fabricated polymeric fibers have been studied with respect to the change in the processing parameters, such as spinning speed, collector distance, and the diameter dimension of the jetting opening, taking into account the physical properties of polymer solutions such as concentrations and viscosities. The conventional disc diffusion technique was used in order to evaluate the antibacterial characteristics of the biocomposite nanofibers that were created and tested against Gram-positive and Gram-negative bacteria. Due to the piezoelectric effect of PVDF-Trfe and the significant antibacterial activity of myrrh, the prepared biohybrid nanofibers will open new avenues toward tissue engineering and wound healing applications.

Keywords: Bio-composite; Piezoelectric; PVDF-TrFE; Myrrh; Nanofiber; Wound Healing, Gyrospun



INVESTIGATIONS OF PHYSICAL PROPERTIES OF LITHIUM-BASED CHALCOPYRITE SEMICONDUCTORS

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Abstract

This work presents the computational results based on the Density Functional Theory (DFT) using the Linear Augmented Wave (FP-LAPW) method adopted in the Wien2K computer code to compute the physical properties of ternary chalcopyrite materials. LiXTe2 (Al, Ga). For the exchange correlation potential, local density estimates (LDA) and (GGA) were used to study the structural parameters of chalcopyrite. The mBJ (potential of LDA-GGA) approximation was used to calculate the linear electronic and optical properties of the composite. The results obtained were compared with other theoretical and experimental work. **Keywords:** Chalcopyrie, LiXTe2, DFT, FP-LAPW, mBJ, semiconductors.



SYNTHESIS, CHARACTERIZATION AND APPLICATION OF BIFUNCTIONAL REACTIVE DYES ON COTTON-NYLON BLEND FABRICS

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Abstract

In this study, two monazo dichlorotriazinyl reactive dye were synthesized. The synthesis involved diazotization, then coupling with 1-naphthol-8-amino3-6-disulphomic acid (H-acid) and then condensation with cyanuric Chloride. The reactive dyes were applied on cotton-Nylon blend fabric to assess dyeing performance. Spectrophotometric studies were carried out to investigate the wavelength of maximum absorption (λ max). The percentage dye exhaustion, effects of Temp. pH and duration of dyeing of the dyed samples were evaluated. The resultant dyes were characterized using standard spectroscopic methods. The results of the specphotometric analysis revealed that λ max of the two dyes were 590mm and 600nm for dye (a) and (b) respectively. The wavelength of maxmum absorption of the dyes in ethanol, water and acetone were 600nm, 590nm for dye (a) and 600, 570 and 480nm for (b) the %dye exhaustion were in the range of 70 – 80% and the fastness rating were found to be between very good to excellent.

Keywords: Bifunctional Spectrophotometric analysis, Dyeing performance monoazo, Cotton-Nylon blend Fabric and %dye exhaustion.



THE ROLE OF BUILDING INFORMATION MODELING (BIM) IN THE CONSTRUCTION INDUSTRY: ESSENTIAL KNOWLEDGE FOR PROFESSIONALS

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ABSTRACT

This study examines the critical role of Building Information Modeling (BIM) in the construction industry and its significance for professionals. BIM serves as a comprehensive information management system designed to facilitate the flow of information and enhance collaboration throughout the planning, design, construction, and operational phases of projects. The primary aim of this research is to understand BIM's impact on construction projects and the challenges professionals face in adapting to these processes. Through a literature review, the study highlights the benefits of BIM in areas such as information management, collaboration, and project efficiency. The findings are systematically analyzed under ten main headings and address topics such as the importance of participation in BIM processes, the planning of information requirements, the strategic role of the BIM execution plan, and the creation of a responsibility matrix. These insights contribute to the effective implementation of BIM in construction projects and support the enhancement of project success. This study is structured into seven sections. The first section introduces the background and problem statement. The second reviews existing studies related to BIM. The third section summarizes the methodology. The fourth presents the findings under the ten main headings derived from the research. The fifth interprets the findings. The sixth offers practical recommendations for professionals; and the seventh concludes the study while highlighting its contributions to the field.

Keywords: Building Information Modeling, BIM, Construction Industry, Role, Professional.

INTRODUCTION

Building Information Modeling (BIM) has emerged as a transformative approach in the construction industry, revolutionizing the ways in which projects are planned, designed, and executed (Akram et al., 2019). The literature available emphasizes BIM's potential to enhance collaboration, improve information management, and increase overall efficiency in construction projects. Research indicates that BIM facilitates better decision-making, reduces errors, and minimizes project delays, making it an essential tool for professionals in the construction industry (Ahankoob et al., 2022). Despite its numerous benefits, the adoption and implementation of BIM present several challenges that should be addressed.

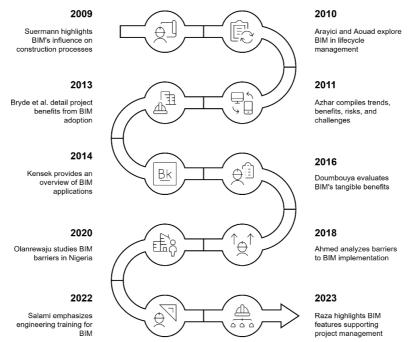
A significant issue identified in the literature is the lack of standardization and understanding of BIM processes among construction professionals. Many practitioners struggle with integrating BIM into existing workflows and effectively managing information throughout the project lifecycle (Fadeyi, 2017; Latiffi et al., 2016). This study aims to provide a comprehensive analysis of BIM's role in the construction industry while equipping professionals with the essential knowledge needed to effectively tackle these challenges.

The objective is to systematically examine the critical aspects of BIM, from its fundamental principles to its practical applications in construction projects.



By conducting a thorough literature review and organizing the findings under ten main headings, this study seeks to ensure a clear and detailed understanding of BIM processes. Each heading is thoroughly explained to enable construction professionals to grasp the significance of BIM and its impact on their work. The method employed includes the collection and analysis of relevant literature, followed by the synthesis of findings based on the identified ten main headings.

This study is structured into seven sections. The first section introduces the background and problem statement. The second reviews existing studies related to BIM. The third section summarizes the methodology. The fourth presents the findings under the ten main headings derived from the research. The fifth interprets the findings. The sixth offers practical recommendations for professionals; and the seventh concludes the study while highlighting its contributions to the field



The Evolution of BIM in the Construction Industry

Figure 1. The evolution of BIM in the construction industry.

LITERATURE REVIEW

Building Information Modeling (BIM) has emerged as a transformative force in the construction industry, reshaping processes, improving efficiency, and facilitating collaboration among stakeholders. As seen in Figure 1, the section provides a comprehensive literature review of BIM's impact through various studies conducted over the years.

• Suermann (2009) highlighted the significant influence of BIM on construction processes, noting its capacity to streamline project management and enhance communication among diverse teams (Suermann, 2009). In a follow-up study, Suermann and Issa (2009) assessed industry perceptions regarding BIM, revealing a growing recognition of its benefits, although challenges remain pervasive (Suermann & Issa, 2009).



• Arayici and Aouad (2010) explored BIM within the context of construction lifecycle management, underscoring its role in managing information throughout various project stages (Arayici & Aouad, 2010). Becerik-Gerber and Kensek (2010) further elaborated on emerging research directions, indicating that ongoing advancements in BIM technology continue to shape its application in architecture, engineering, and construction (Becerik-Gerber & Kensek, 2010).

• Olatunji et al. (2010) detailed the benefits of BIM processes in the construction industry, calling attention to the enhanced efficiency and reduced waste it can provide (Olatunji et al., 2010). Azhar (2011) compiled trends, benefits, risks, and challenges linked to BIM adoption, reinforcing the need for professionals to stay informed and adapt to changing technologies (Azhar, 2011).

• Jung and Joo (2011) presented a practical implementation framework for BIM, facilitating ease of application across projects (Jung & Joo, 2011). Azhar et al. (2012) discussed the current state and future potential of BIM, envisioning a landscape where its usage will be increasingly ubiquitous in construction practices (Azhar et al., 2012).

• Bryde et al. (2013) detailed the project benefits arising from BIM adoption, emphasizing improved project outcomes and stakeholder satisfaction (Bryde et al., 2013). This sentiment was echoed by Latiffi et al. (2013), who examined BIM's application within Malaysia, highlighting both opportunities and hurdles (Latiffi et al., 2013).

• Sacks and Pikas (2013) focused on educational aspects, analyzing industry requirements and gaps in education concerning BIM technologies (Sacks & Pikas, 2013). Zahrizan et al. (2013) used qualitative methods to investigate BIM adoption barriers in Malaysia, contributing vital insights into local industry nuances (Zahrizan et al., 2013).

• Research by Gardezi et al. (2014) pinpointed challenges specific to BIM implementation in Malaysia, revealing sector-specific obstacles (Gardezi et al., 2014). Kensek (2014) provided a robust overview of BIM applications, with a focus on its theoretical underpinnings and practical implications (Kensek, 2014).

• Zakari et al. (2014) identified driving factors and barriers to BIM implementation, while Rokooei (2015) underscored necessities and challenges associated with BIM in project management (Rokooei, 2015; Zakari et al., 2014). Recent studies, such as those by Diaz (2016) and Doumbouya et al. (2016), evaluate the tangible benefits of BIM and its capacity for enhancing construction project effectiveness (Diaz, 2016; Doumbouya et al., 2016).

• Further contributions from Latiffi et al. (2016) delineated the roles and responsibilities of construction stakeholders employing BIM, while Fadeyi (2017) addressed its role in sustainable building practices (Fadeyi, 2017; Latiffi et al., 2016). Ghaffarianhoseini et al. (2017) provided insights into BIM's uptake, emphasizing its clear benefits while addressing implementation challenges (Ghaffarianhoseini et al., 2017).

• Later reviews by Ahmed (2018) and Borrmann et al. (2018) analyzed barriers to BIM implementation and offered a comprehensive overview of the technology's development and future directions (Ahmed, 2018; Borrmann et al., 2018). Gholizadeh et al. (2018) studied the diffusion of BIM functions, reinforcing its growing integration into industry practices (Gholizadeh et al., 2018).



• Research on the Malaysian construction industry by Musa et al. (2018) further illustrated the realities of BIM benefits and challenges (Musa et al., 2018). Akram et al. (2019) explored BIM's role in enhancing construction safety through science mapping, while Gamil and Rahman (2019) examined awareness and challenges faced in Yemen (Akram et al., 2019; Gamil & Rahman, 2019).

• The barriers to BIM implementation in Nigeria were studied by Olanrewaju et al. (2020), revealing further geographical insights into the challenges faced by the industry (Olanrewaju et al., 2020). Saka and Chan (2020) addressed knowledge and skills requirements for quantity surveyors within a BIM context, asserting the necessity for professional development (Saka & Chan, 2020).

• Recent studies, such as those by Adam et al. (2021) and Ahankoob et al. (2022), continued to examine BIM readiness among construction professionals and the role of contractors in realizing BIM's potential (Adam et al., 2021; Ahankoob et al., 2022). Lastly, Salami and Alothman (2022) emphasized the importance of engineering training for effective BIM implementation, while Raza et al. (2023) highlighted features of BIM that support project management knowledge areas (Raza et al., 2023; Salami & Alothman, 2022).

In conclusion, the extensive body of literature demonstrates a growing recognition of BIM's critical role in the construction industry. While various studies illustrate its benefits, risks, and challenges, the ongoing evolution of BIM technology underscores the need for continuous learning and adaptation among construction professionals.

METHOD

The method employed in this study is based on a detailed literature review to examine the role and importance of BIM applications in the construction industry. During the research process, articles, books, and various publications in the existing literature were reviewed, and information on the use of BIM in construction projects was collected. This collected information was organized under ten main headings, and these headings are explained in detail to provide a comprehensive understanding of BIM processes and their importance in construction projects. This structured approach ensures a well-rounded exploration of BIM's contributions to the field, providing essential knowledge for professionals engaging with this tool in the construction industry.

FINDINGS

This study addresses the role of BIM in the construction industry and its significance for professionals in the field. The findings under ten main headings highlight the importance of participation in BIM processes, the impact of information management across all roles, the expansion of BIM's boundaries, and the necessity of planning information requirements effectively. As shown in Figure 2, these include:



The Role of Building Information Modeling (BIM) in the Construction Industry

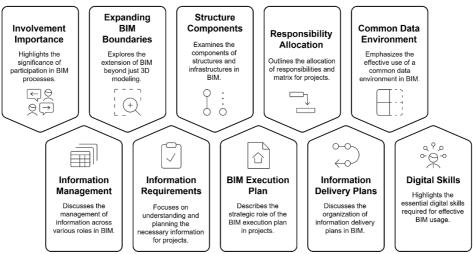


Figure 2. The role of building information modeling (BIM) in the construction industry.

Importance of Involvement in BIM Processes

All professionals involved in planning, design, construction, operation, and maintenance should engage in BIM processes, whether directly or indirectly. The ISO 19650 standard requires all participants to share and manage information through a controlled digital process in a Common Data Environment (CDE). This collaborative approach guarantees a seamless information flow at every project stage, enhancing efficiency and effectiveness. BIM integration reduces information gaps and misunderstandings, leading to more successful project completions. Moreover, it fosters early detection and resolution of issues, resulting in higher quality and safer structures while ensuring timely, budget-compliant project completion.

Information Management for All Roles

Information is essential for construction projects, crucial for all professionals. Architects need design data, engineers require structural calculations, and contractors seek detailed plans and schedules. Effective communication and information exchange are key to project success. BIM streamlines this process by offering a centralized platform for storing, accessing, and updating data in real-time. This allows stakeholders to access current information, perform tasks accurately, and ensures continuous information flow, minimizing gaps and misunderstandings, which enhances project efficiency and success.

Expanding the Boundaries of BIM: Beyond 3D Model

While 3D models and clash detection are key parts of BIM, its reach is much broader. Under the ISO 19650 standard, BIM encompasses models, data, drawings, schedules, specifications, estimates, analysis reports, product information, safety and environmental data, certifications, and checklists. This extensive management ensures thorough documentation and flow of information from design to construction and beyond, facilitating smoother project progression. BIM also aids early problem detection and resolution. By centralizing project information, collaboration is improved, leading to better management, enhanced quality, and greater customer satisfaction.



Understanding and Planning Information Requirements

Information requirements are critical to the success of a project. An information requirement specifies the type of information needed, who should provide it, when it is needed, why it is necessary, and where it should be presented. Different levels of information requirements include Organizational Information Requirements (OIR), Asset Information Requirements (AIR), Project Information Requirements (PIR), and Employer's Information Requirements (EIR). Accurately defining and managing these requirements is crucial for project success, ensuring that all participants understand their responsibilities and needs clearly. This clarity helps prevent information gaps and misunderstandings. Proper management of information significantly enhances overall project efficiency and leads to more successful outcomes.

Understanding the Components of Structures and Infrastructures

Buildings and infrastructure consist of complex systems with numerous components. Understanding their structure is crucial for effective management. Classification systems like Uniclass and Omniclass help professionals categorize and manage information consistently, fostering a common language across roles. This enhances communication and coordination, allowing projects to progress efficiently. Proper comprehension ensures seamless information flow, preventing gaps and misunderstandings. With these systems, all participants use the same data, enhancing project efficiency and contributing to successful outcomes.

Strategic Role of the BIM Execution Plan

The BIM Execution Plan (BEP) is a detailed methodology statement document developed by the delivery team or supply side in response to Employer's Information Requirements (EIR). The BEP outlines the standard methods and procedures the delivery team will utilize to implement BIM or information management within the project. It includes elements such as project goals and objectives, roles and responsibilities, information delivery procedures, and quality control measures. Defined project goals and objectives explicitly clarify the targets for BIM implementation, while roles and responsibilities delineate the detailed roles of all stakeholders involved. Information delivery procedures encompass file formats, naming conventions, and data exchange protocols, while quality control measures focus on maintaining the accuracy and reliability of information. The BEP serves as a roadmap for the project, guiding the delivery team in effectively implementing BIM, subsequently promoting orderly and efficient project advancements, and enhancing project success.

Responsibility Allocation and Matrix for Projects

To define information requirements, it is crucial to list all assets, elements, systems, and products involved in the project and assign responsibilities according to roles and tasks. This is known as the Responsibility Matrix and is a critical tool for identifying information requirements. It specifies what type of information is needed, who will provide it, when it is required, why it is necessary, and where it should be delivered. This information enables everyone involved in the project to understand their responsibilities and ensures systematic collection and management of data. The responsibility matrix supports seamless information flow and collaboration during projects. Clearly defined responsibilities help prevent information gaps and misunderstandings. Timely and accurate information delivery enhances overall project efficiency and contributes to successful outcomes, ensuring projects are completed on time and within budget.



Organization of Information Delivery Plans

In BIM projects, information is delivered through digital files uploaded to the CDE, managed by Information Delivery Plans (MIDP and TIDP). The Task Information Delivery Plan (TIDP) specifies file requests from particular disciplines or suppliers, while the Master Information Delivery Plan (MIDP) provides a comprehensive list from all disciplines, ensuring systematic and regular information collection. These plans aid effective information delivery management, organize data access, and define responsibilities for delivery, ensuring consistency and currency. Improved decision-making is fostered, and information gaps are reduced. Successful information delivery execution enhances project efficiency and leads to better outcomes.

Effective Use of Common Data Environment

Information is stored and shared as carefully managed digital files or containers within the Common Data Environment (CDE). The CDE is meticulously managed through file naming conventions and approval processes to ensure that data is always accessible, reliable, and usable. There are three types of information in the CDE: graphical data, non-graphical data, and documents. Graphical data consists of 3D models and drawings that visually describe the size, shape, location, and spatial relationships of each component. Non-graphical data comprises properties and attributes that define each component's physical and functional characteristics. Documents include records related to compliance, contractual obligations, safety, and maintenance information. The CDE allows for the centralized storage of all information, facilitating easier access and management. This structure ensures uninterrupted information flow and enhances collaboration throughout projects.

Essential Digital Skills for BIM

Everyone working with BIM should possess three essential digital skills. First, proficiency in working with tabular data is crucial. Managing spreadsheets and data tables forms the foundation of any database and plays a critical role in data analysis and management. This skill enables accurate analysis and interpretation of data. Secondly, the ability to interact with the CDE is required. Activities within the CDE—such as uploading, downloading, reviewing, approving, and accepting files—are critical to information management processes in projects. Lastly, the ability to use 3D model viewers is essential. The capability to visualize, navigate, review, comment on, and extract views or data from 3D models is pivotal for effective project management. These skills are necessary for efficiently managing information and collaborating in a BIM environment.

DISCUSSION

This study emphasizes the importance of BIM in construction projects. Professionals involved in BIM should have essential digital skills to manage information effectively. Correctly defining information requirements based on the ISO 19650 standard is critical for project success. Following this standard promotes improved information sharing and collaboration among stakeholders, resulting in streamlined project processes. Tools like the Master Information Delivery Plan (MIDP), Task Information Delivery Plan (TIDP), and Common Data Environment (CDE) support continuous information flow and enhance collaboration. These tools ensure that all project participants have access to up-to-date information, which aids in effective decision-making, increases project efficiency, and improves outcomes.



The BIM Execution Plan (BEP) and responsibility matrix clarify tasks, reducing information gaps and misunderstandings. In summary, effective BIM implementation enhances project quality and customer satisfaction while promoting timely and budget-compliant completions. The study highlights BIM's crucial role in information management and its benefits in identifying and addressing project issues early, leading to more sustainable and successful construction outcomes.

RECOMMENDATIONS

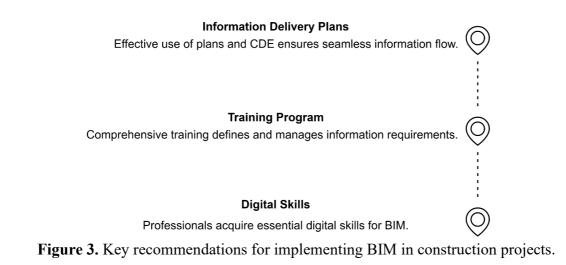
As depicted in **Figure 3**, this study presents key recommendations for implementing BIM in construction projects:

• First, all professionals involved in BIM should have essential digital skills, including handling tabular data, using CDE, and leveraging 3D visualization tools. These skills will enhance information management and collaboration.

• Second, a comprehensive training program is crucial for defining and managing information requirements, ensuring participants understand their information needs and responsibilities. The training should address different levels of information requirements: Organizational Information Requirements (OIR), Asset Information Requirements (AIR), Project Information Requirements (PIR), and Employer Information Requirements (EIR), thereby reducing information gaps.

• Finally, effective use of Information Delivery Plans (MIDP and TIDP) and a CDE is essential for seamless information flow, enabling systematic information collection and sharing. Clearly defined responsibilities for information delivery will minimize deficiencies and boost project efficiency. Supporting documents like the BIM Execution Plan (BEP) and a responsibility matrix will clarify tasks, promoting more efficient project progress. These recommendations enhance BIM implementation and project success.

Key Recommendations for Implementing BIM in Construction Projects





CONCLUSION

This study has thoroughly examined the role and significance of Building Information Modeling (BIM) within the construction industry. The key issue addressed in this research is understanding the impact of BIM processes on construction projects and the challenges professionals face in adapting to these processes. The aim of the study was to provide professionals with essential knowledge by delving into the advantages and applications offered by BIM. The literature review revealed the benefits of BIM in areas such as information management, collaboration, and project efficiency. A systematic analysis was conducted on the information categorized under ten main headings. Findings encompassed critical topics including the importance of participation in BIM processes, information management, the expansion of BIM's boundaries, and planning information requirements.

In the discussion section, the implications of these findings on construction projects were evaluated, and recommendations were presented. It was determined that BIM is a crucial tool for managing information flow and enhancing collaboration in construction projects. This study detailed the advantages of understanding BIM in relation to the components of structures and infrastructures, the strategic role of a BIM execution plan, and the creation of a responsibility matrix. Additionally, topics such as the organization of information delivery plans, the effective use of shared data environments, and the necessary digital skills for working with BIM were addressed. These findings contribute to achieving more efficient and successful outcomes in construction projects.

The research highlights that, alongside the benefits provided by BIM in construction projects, professionals should possess fundamental digital skills for the effective implementation of these processes. Accurately defining and managing information requirements is essential for project success. The effective utilization of tools such as shared data environments and information distribution plans ensures a seamless flow of information and strengthens collaboration. These recommendations contribute to the effective application of BIM in construction projects and enhance overall project success.

In conclusion, this study has comprehensively illustrated the critical role of BIM in the construction industry and its value for professionals. The advantages offered by BIM aid in the early detection and resolution of issues encountered in projects, thereby contributing to the realization of more sustainable and successful endeavors within the construction industry. The findings of this research aim to promote the effective use of BIM in construction projects, ultimately enhancing the overall performance and efficiency of the industry.

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UNDERSTANDING CLIENT REQUIREMENTS IN BUILDING INFORMATION MODELING (BIM)

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ABSTRACT

Understanding client requirements is crucial for the successful execution of construction projects. This study aims to identify and analyze fundamental client expectations within the BIM context. Through a comprehensive literature review, nine key client requirements are underscored: scope, time, cost, quality, safety, value, sustainability, risk, and information. The capabilities of BIM are examined in relation to these expectations, specifically focusing on 3D modeling for scope, 4D scheduling for time, 5D controlling for cost, and 6D analyzing for quality. This study is organized into seven sections. The introduction section offers an overview of the problem, objectives, and methodology. The literature review section discusses current research and theoretical foundations related to BIM and client requirements. The method section outlines the approach used to identify and analyze client needs. The findings section presents nine key client requirements identified through analysis. The discussion section interprets these findings and emphasizes their implications for construction projects. The recommendations section suggests ways to enhance the understanding and management of client requirements in BIM. Lastly, the conclusion section summarizes the key insights from the research.

Keywords: Client Requirements, Building Information Modeling, BIM, Construction Project Management, Construction Industry.

INTRODUCTION

Before embarking on any construction project, it is crucial to have a clear understanding of what clients expect from the endeavor. This understanding lays the groundwork for transforming clients' needs and desires into a tangible form throughout the design and construction processes (A. Dakhil & Alshawi, 2014). Possessing such clarity from the onset of a construction project reduces misunderstandings among project stakeholders and helps prevent unnecessary conflicts during the building phase and throughout the life cycle of the structure. In the construction industry, comprehending client requirements is essential for the successful execution of projects (Kamara et al., 2000).

Building Information Modeling (BIM) has emerged as a revolutionary tool that facilitates the efficient planning, design, construction, and management of building and infrastructure projects. However, the complexity of BIM, coupled with varied client expectations, necessitates a comprehensive understanding of client requirements in order to maximize the benefits that BIM can offer (A. J. Dakhil et al., 2019). This study addresses the critical issue of identifying and meeting client expectations within the BIM context, emphasizing the significance of effective information management and adherence to industry standards.

The primary objective of this study is to systematically identify and analyze key client requirements in BIM. By conducting a thorough literature review, this research aims to provide a clear understanding of what clients expect from BIM and how those expectations can be met.



The methodology encompasses the categorization and explanation of each requirement identified in the existing literature, ensuring a comprehensive perspective on the subject matter.

This study is organized into seven sections. The introduction section offers an overview of the problem, objectives, and methodology. The literature review section discusses current research and theoretical foundations related to BIM and client requirements. The method section outlines the approach used to identify and analyze client needs. The findings section presents nine key client requirements identified through analysis. The discussion section interprets these findings and emphasizes their implications for construction projects. The recommendations section suggests ways to enhance the understanding and management of client requirements in BIM. Lastly, the conclusion section summarizes the key insights from the research.

LITERATURE REVIEW

The processing of client requirements is a critical aspect in the architecture, engineering, and construction industries, particularly with the integration of Building Information Modeling (BIM) technologies. As depicted in **Figure 1**, Kamara et al. (1999) introduced a new approach to client requirements processing in construction through Quality Function Deployment (QFD), establishing a foundational method for effectively managing these requirements (Kamara et al., 1999). This was further refined by Kamara and Anumba (2000), who emphasized a concurrent life-cycle design and construction perspective, demonstrating the need for aligning client needs with the design and construction phases (Kamara & Anumba, 2000)

Evolution of Client Requirements Processing in BIM

1999 - Introduction of QFD by Kamara et al.
2000 - Concurrent life-cycle design emphasized by Kamara and Anumba
2010 - BIM technology investigated by Shahrin et al.
2011 - Sebastian's analysis of BIM's evolving roles
2013 – BIM modeling in low-income housing by Baldauf et al.
2014 - BIM benefits and maturity explored by Dakhil and Alshawi
2015 - Client-oriented GIS integration by Delgado et al.
2016 – Facilities Management's role in BIM strategy by Ashworth et al.
2017 - Introduction of Design Quality Indicator by Kamara
2019 — Critical success competencies for BIM by Dakhil et al.
Figure 1. Evolution of client requirements processing in BIM.

In subsequent works, Kamara et al. (2000) proposed a comprehensive process model for client requirements processing, highlighting the dynamics between various stakeholders (Kamara et al., 2000).



Shahrin et al. (2010) investigated how BIM technology can effectively record, translate, and deliver client requirements, closing the gap between what clients want and what the project delivers by making it easier to manage data and see it (Shahrin et al., 2010). The evolving roles of clients, architects, and contractors in the context of BIM have been critically analyzed by Sebastian (2011), who noted that BIM not only enhances collaboration but also shifts responsibility towards a more client-focused approach (Sebastian, 2011). This is complemented by Nummelin et al. (2011), who discussed managing building information and client requirements from a constructor's perspective, underscoring the importance of integrating client needs into the construction supply chain (Nummelin et al., 2011).

Baldauf et al. (2013) examined the use of BIM for modeling client requirements specifically in low-income housing, illustrating the versatility of BIM applications across diverse project types (Baldauf et al., 2013). Dakhil and Alshawi (2014) further explored the relationship between BIM benefits and maturity from the client's viewpoint, stressing the need for clients to embrace BIM technologies to enhance project delivery and satisfaction (A. Dakhil & Alshawi, 2014). Navendren et al. (2015) examined how project teams and clients develop information requirements for the Asset Information Model (AIM), highlighting the collaborative nature of modern construction projects (Navendren et al., 2015). Al Ahbabi and Alshawi (2015) advocated for a continuous improvement approach to BIM within client organizations, which can lead to more responsive and effective project execution (Al Ahbabi & Alshawi, 2015).

Delgado et al. (2015) proposed a client-oriented integration of construction processes with building Geographic Information Systems (GIS), emphasizing the necessity of aligning technological advancements with client requirements to improve workflow efficiencies (Delgado et al., 2015). Sacks et al. (2016) reviewed protocols, guides, and standards related to BIM for large construction clients, providing insights into best practices that can be adapted for effective client engagement (Sacks et al., 2016). The significance of Facilities Management (FM) in shaping a BIM strategy that aligns with client asset management was discussed by Ashworth et al. (2016), revealing the critical role of post-construction phases in maximizing client satisfaction (Ashworth et al., 2016). Further focusing on a client-oriented project process, Kamara (2017) introduced the Design Quality Indicator (DQI) tool to maintain emphasis on client requirements throughout project progression (Kamara, 2017).

Finally, Dakhil et al. (2019) identified critical success competencies necessary for effective BIM implementation from the perspective of UK construction clients, while Baldauf et al. (2020) illustrated the application of BIM in managing client requirements in social housing projects, further showcasing BIM's potential in addressing specific client needs (Baldauf et al., 2020; A. J. Dakhil et al., 2019). Together, these studies underscore the importance of understanding and integrating client requirements in BIM processes to enhance project delivery, collaboration, and overall client satisfaction in the construction industry.

METHOD

This section describes the methodology employed to analyze understanding client requirements in BIM. The approach involved a comprehensive literature review to extract detailed insights into what clients expect from BIM. The identified fundamental client requirements were then systematically categorized and synthesized. Each requirement is elaborated upon with explanations that provide a thorough understanding of how BIM processes function and the critical importance of these expectations in construction projects.



FINDINGS

The analysis of client requirements in BIM has revealed nine fundamental expectations that are critical to the success of construction projects. As shown in **Figure 2**, these expectations include:

Scope

Clients have a clear need to understand the full scope of a project and what they can expect to achieve from it. The three-dimensional (3D) aspects of BIM facilitate the visualization of project scope, enabling all stakeholders to grasp the project more effectively. Through BIM, a clear comprehension of what is included at every project phase, the deliverables, and overall objectives is established. This clarity not only manages stakeholder expectations but also mitigates potential misunderstandings.

Time

Clients seek precise information regarding the completion time and key delivery dates of their projects. The integration of the time dimension (4D) into BIM plays a crucial role in project and logistical planning, as well as in safety risk assessments. Incorporating time into the digital model enables project managers to create detailed schedules, plan logistics more efficiently, and evaluate potential safety risks. This capability ensures adherence to the project timeline and minimizes the likelihood of delays.

Cost

Clients desire assurance regarding the project's overall cost. The addition of the cost dimension (5D) within BIM enhances pre-construction value assessments and ongoing cost control throughout the project's lifecycle. BIM allows for more accurate budgeting and financial planning, thereby reducing the risk of cost overruns. Moreover, it enables a thorough analysis of the costs associated with materials and labor, facilitating more effective cost management.

Figure 2. Client expectations in BIM for construction projects.



Quality

Quality is a critical factor in meeting client expectations for the project. The 6D aspect of BIM allows for complex performance and sustainability analyses to be conducted before substantial capital expenditures are made. Project managers can make informed decisions by analyzing performance and sustainability metrics, enhancing the long-term efficiency and sustainability of the project. This process contributes to an increase in the quality of the final product, leading to higher client satisfaction.

Safety

For clients, safety is among the highest priorities. There is an expectation that no injuries will occur during the construction process and that job safety will be maintained. BIM facilitates logistics planning and safety risk assessments, aiding in the early identification and mitigation of potential risks. This contributes to a safer construction process and helps prevent workplace accidents.

Value

Clients want assurance that their projects represent a good value investment. BIM promotes effective information management, leading to efficient project execution while minimizing waste costs and unnecessary delivery delays. This provides better evaluation of the investment and enhances overall project outcomes, resulting in client satisfaction as they see a return on their investment.

Sustainability

Clients are increasingly focused on minimizing the environmental impact of their projects and achieving sustainable solutions. BIM captures critical asset data in a structured and organized manner throughout the design and construction phases, supporting the entire lifecycle of operations through a digital twin. This digital twin serves as a digital replica of the physical asset, containing all the necessary information for its operation and maintenance. Consequently, this enables projects to be more sustainable and reduces their environmental footprints.

Risk

Clients seek to enhance the quality and performance of outcomes while reducing wasted costs, unnecessary delivery delays, and associated risks. BIM enables the early detection and management of potential risks through effective information management. This streamlines the project process, promoting a smoother and more efficient workflow and consequently increasing client satisfaction.

Information

Information management is critical for the planning, design, construction, and operation of construction projects. Organizing and digitizing information within BIM according to the ISO 19650 series of standards is vital for meeting the needs of clients and owners (ISO/DIS19650-6, 2024; ISO19650-1, 2024; ISO19650-2, 2024; ISO19650-3, 2024; ISO19650-4, 2024; ISO19650-5, 2024). These standards ensure that information is accurate, accessible, and reliable, facilitating effective information management in projects and achieving established project goals.

DISCUSSION

The findings indicate that understanding and addressing client requirements in Building Information Modeling (BIM) is essential for the successful execution of construction projects. The integration of various dimensions within BIM—3D for scope, 4D for time, 5D for cost, and 6D for quality—illustrates a comprehensive approach to meeting client expectations.



Effective information management through BIM facilitates risk mitigation and enhances sustainability, resulting in higher levels of client satisfaction and project efficiency. Adherence to ISO 19650 standards further boosts the accuracy, accessibility, and reliability of information, thus streamlining the achievement of defined project goals.

Overall, the structured use of BIM leads to improved project outcomes while aligning with a heightened focus on sustainability, ultimately addressing critical client requirements. This positions BIM as an indispensable tool in contemporary construction practices, underscoring its importance in navigating and fulfilling the complexities of client demands. By prioritizing client needs and ensuring that project deliverables align with these expectations, BIM not only enhances operational effectiveness but also fosters a collaborative environment that is crucial for stakeholder engagement throughout the construction lifecycle.

RECOMMENDATIONS

In this study, some key recommendations have been made to improve the understanding and management of client requirements for BIM as shown in **Figure 3**. First, the implementation of comprehensive training programs for all project stakeholders is crucial. Ensuring that team members are knowledgeable about BIM processes and ISO 19650 standards will equip them with the skills necessary to manage and meet client requirements effectively. Furthermore, fostering improved communication and collaboration among all stakeholders is essential; creating an environment where clear communication and seamless information sharing can occur will aid in aligning expectations and reducing misunderstandings.

Additionally, it is advisable to invest in advanced BIM tools that support 4D and 5D integrations, enabling better project planning, cost control, and risk management. Emphasizing sustainability by leveraging BIM capabilities for performance and sustainability analyses should be prioritized during project planning and execution. Lastly, regular reviews and updates of information management practices are vital to ensure compliance with the latest ISO standards and to enhance project outcomes. These recommendations aim to strengthen the overall understanding and management of client requirements in BIM, ultimately leading to more successful project results.

Enhancing BIM Client Requirement Management

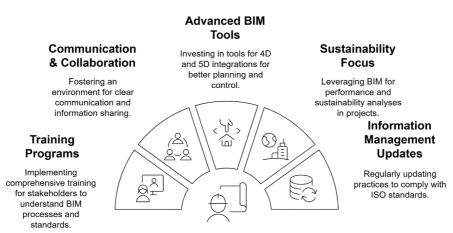


Figure 3. Enhancing BIM client requirement management.

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CONCLUSION

In conclusion, understanding client requirements within the context of BIM is fundamental to the success of construction projects. The ability of BIM to visualize project scope (3D) in three dimensions, integrate time (4D) and cost (5D) elements, and conduct complex performance and sustainability analyses (6D) demonstrates its comprehensive approach to construction project management. This approach not only clarifies client expectations but also facilitates precise scheduling, accurate cost control, and high-quality outcomes. Increased client satisfaction and overall project success are thus achieved. Furthermore, it's essential to recognize the significance of security, value, and sustainability in client requirements. BIM plays a crucial role in enhancing safety assessment and logistical planning, creating a safer construction environment. Efficient information management processes within BIM reduce waste costs and delays, ultimately providing better value for investments and promoting sustainable construction practices.

The integration of BIM and adherence to ISO 19650 standards are critical for meeting client needs and achieving successful construction project results. By offering a structured framework for project scope, time, cost, quality, security, value, sustainability, risk, and information management, BIM enables construction professionals to leverage its capabilities to increase project efficiency, minimize risks, and enhance customer satisfaction. The recommendations presented in this article aim to improve the understanding and management of client requirements in BIM, leading to superior project outcomes and a more sustainable construction industry. Continued development and adoption of BIM and ISO standards will further encourage innovation and excellence within the construction industry.

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IMPLEMENTATION OF VISUAL MANAGEMENT PRACTICE ON SAFETY PERFORMANCE ON CONSTRUCTION SITES IN ABUJA

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Abstract

Effective Visual Management (VM) practices play great role in ensuring safety on construction sites. However, there are some challenges in the implementation of VM in construction industry The study assesses the drivers and barriers to the implantation of visual management practices on construction sites. A quantitative research approach was adopted, using a structured questionnaire distributed to actives construction sites in Abuja. 102 questionnaires were shared among the participants of which 86 were retrieved and 73 were deemed fit for analyses using mean item scores. The major barriers to VM implementation on construction sites are safety culture (3.63), lack of government support (3.61) and technical barriers (3.60) while, attitude (4.16), training and coaching (3.95) and management support (3.91) are the major drivers to VM implementation on construction sites are workplace organization (4.01), management involvement (4.0) and workers involvement (3.93). Safety culture should be cultivated to enhance the implementation of VM practices on construction sites, the study therefore recommend that safety culture should be entrenched in order to reduce safety mishaps on construction sites.

Keywords: Visual management; Construction industry; drivers & barriers, safety implementation; safety culture.

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INNOVATIVE APPROACHES FOR UTILIZING WASTEWATER TREATMENT BY-PRODUCTS IN ECO-EFFICIENT CEMENTITIOUS MATERIALS: A REVIEW

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Abstract

The increasing global demand for sustainable construction materials has driven research into alternative binders and aggregates derived from waste streams. Sewage sludge ash (SSA), a by-product of wastewater treatment, is emerging as a promising supplementary material for cement and mortar production due to its pozzolanic nature and environmental benefits. This review critically examines recent advancements in SSA utilization, focusing on its effects on mechanical performance, durability, and environmental sustainability.

A comprehensive assessment of SSA's physicochemical properties, hydration mechanisms, and microstructural behavior is provided. Research findings indicate that SSA, when properly processed, can enhance certain properties of cementitious materials, including resistance to aggressive environments and thermal stability. Additionally, the incorporation of SSA contributes to the reduction of carbon emissions associated with traditional cement production and minimizes landfill disposal.

Despite these advantages, challenges such as variability in SSA composition, leaching concerns, and optimal replacement ratios must be addressed to standardize its application in the construction industry. This review synthesizes current research findings, highlights practical applications, and proposes future directions for SSA integration into sustainable building materials.

Keywords: Sewage sludge ash, wastewater treatment, eco-efficient cement mortar sustainability.



THE ENDURING LEGACY OF MEDIEVAL MONSTERS: MARGINALIA, MEANING, AND MODERN INTERPRETATION

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Medieval Maps and Marginalia. <u>Medieval Maps and Marginalia: Monsters and Hidden Meanings – The</u> <u>Historians Magazine</u>

Abstract

Medieval maps and manuscripts are renowned for their bizarre and imaginative drawings, including fantastical creatures like knightly rabbits riding snail-men and headless Blemmyes with faces on their chests. These beings, originating from ancient stories and often associated with Alexander the Great's travels, represent a unique type of semi-human monster found in medieval art. The belief in these monsters, which began in ancient Greece and Rome, where they were believed to inhabit the world's edges and symbolize corruption, was reignited during the Renaissance with the rediscovery and printing of many ancient texts. These texts, such as Pliny the Elder's Historia Naturalis, written in the first century CE, and Cicero's De Divinatione, played a significant role in shaping modern interpretations of these creatures. The word "monster" comes from the same Latin root as "demonstrate," which means to warn. This reflects the idea that monsters symbolize danger, sin, and divine anger. As more ancient writings became available, people continued to believe that grotesque creatures still lived at the world's edges. Historian Massimo Perrone points out that manuscript illustrators used marginalia, or side illustrations, to make their work more enjoyable, adding humour and engaging stories. This use of marginalia entertained the audience and encouraged modern interpretations and creative expressions, making the study of medieval monsters fascinating. Keywords: Medieval Monster, Marginalia, Folklore, Ancient Greece, Myth and Culture, Manuscript Illustration, Historical Interpretation.

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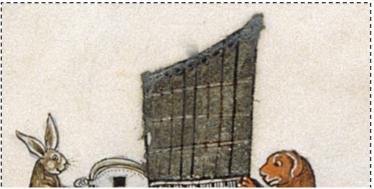


Figure: Gorleston Psalter, 14th century, f. 106v. <u>The Art of the Ordinary:</u> <u>Marginalia as a Window into Medieval Culture – Retrospect Journal</u>



Introduction: Medieval literature thrived in various ways, including drawing, art, and crafts-these forms combined colours, paintings, and traditions, creating a unique cultural experience for European audiences. Medieval literature has left a lasting impact on modern people, and this is how medieval culture became one of the brightest literary traditions in the world. If the audience looked at a medieval manuscript, they would probably notice the interesting images beside the text and appreciate their unique art. ¹Even if they have not seen an actual manuscript, they may

recognize the drawings of rabbits, cats, and snails (O'Reilly,2024) that often go viral online. Medieval manuscripts are famous for ²detailed writing and fun margin art, known as ³marginalia (O'Reilly,2024). This art has been around since the beginning of writing, but the ⁴doodles in medieval manuscripts are particularly fascinating. ⁵The drawings (O'Reilly,2024) include animal musicians, fighting snails, and warrior women. Historians do not know precisely why these drawings were made, but one theory is that they helped people remember ⁶passages. Others suggest they made the manuscripts more understandable or even mocked the text. One thing is clear: these sketches had a purpose, as getting materials back then was not easy. They often depicted subjects that the main text overlooked, including women, servants, and even prostitutes (O'Reilly,2024). ⁷Another idea is that these doodles served as pen trials, where scribes tested their pens on parts of the page that would not be written on later. There are ⁸many types of marginalia, covering themes like religion, sexuality, and everyday life.

¹ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 1st.

² The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 1st.

³ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 1st.

⁴ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 1st.

⁵ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 1st.

⁶⁶ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 2nd.

⁷ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 3rd.

⁸ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 4th.



Scholars ignored them for a long time until ⁹Michael Camille's 1992 book, Image on the Edge: (O'Reilly,2024) The Margins of Medieval Art, argued that they were more than decoration and offered insights into medieval culture. Many of these drawings provided social commentary, intentionally or not. A common theme is role reversal, showing ¹⁰women with weapons and even men being defeated by women. ¹¹Animals also took on human roles, such as rabbits eating at tables (O'Reilly,2024). Some images might depict an upside-down world playfully or serve as political commentary. (O'Reilly,2024) For example, ¹²Harley MS 6563 contains a story about a battle between cats and mice, in which the mice win. This can be seen as a commentary on hunters being chased by their prey. (O'Reilly,2024) Other images offer ¹³moral lessons or highlight the fashion, jobs, or hobbies of the time.

Literature Review

The interest in medieval monsters has captured the attention of scholars for many years. This topic connects literature, history, and cultural studies. Monsters medieval times from often represent societal fears and the unknown. This review looks at different aspects of medieval monsters, including how they are portrayed in art, their mythological roots, and their relevance today. The images of



monsters in medieval manuscripts trace back to ancient texts, representing things that went against nature. The Renaissance renewed interest in classical works, such as Pliny the Elder's Historia Naturalis and Cicero's De Divinatione. Perrone (2020) argues that the illustrations found in manuscripts were not just decoration; they communicated complex social and moral lessons about humanity and the divine. The term "monster" comes from the Latin word "monstrare," meaning "to warn." This helps us understand these beings as symbols of danger and moral failures. Cohen (1996) discusses how monsters reflect societal fears and the worries of their time, allowing us to see them as both real threats and cautionary tales.

⁹ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 4th.

¹⁰ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 5th.

¹¹ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 5th.

¹² The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 5th.

¹³ The Art of the Ordinary: Marginalia as a Window into Medieval Culture. Paragraph 5th.

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Fig: Harley MS 6563, ff. 63v-64r. <u>The Art of the Ordinary: Marginalia as a Window into</u> <u>Medieval Culture – Retrospect Journal</u>

Artistic depictions of monsters appear frequently in medieval literature and maps. They are often found in the margins of illuminated

manuscripts, symbolizing unknown regions,

both geographically and psychologically. According to Majumdar (2023), strange images of creatures like knightly rabbits and Blemmyes challenge our ideas of humanity and the unfamiliar. These images create a dialogue between the audience's expectations and the stories being told. Today, interest in medieval monsters continues, especially in myth studies, cultural history, and popular media. Scholars like Hogle (2002) examine how these images affect modern storytelling and cultural narratives, linking historical fears to current worries. The ongoing fascination with monster mythology shows its lasting importance, suggesting that medieval art and literature themes remain relevant. Looking at monsters from an international perspective highlights shared themes across cultures. The Arthurian legend reveals universal values of heroism and shows how myths can cross geographic boundaries. Majumdar (2023) notes that these legends encourage cross-cultural discussions that enhance our understanding of the monsters in our imagination and connect global stories with local views. Studying medieval monsters through the lenses of history, art, and culture highlights their significance both in the past and today. This review shows that monsters are enduring symbols of societal fears, moral lessons, and the complexity of being human. Future research could explore these creatures further, especially in digital humanities and visual studies, expanding the conversation on their importance in modern culture.



Methodology: The study of medieval monsters examines how they were represented in art, literature, and culture. This research includes several key steps: First, I examine primary texts, like Pliny the Elder's Historia Naturalis and Cicero's De Divinatione, to understand where the idea of monsters comes from and how it has changed over time. I conduct close readings and compare these texts to find themes about monstrosity and its meaning. Next, I analyze medieval manuscripts and artwork, mainly focusing on marginalia, to see how artists showed monsters. This helps to understand how visual elements conveyed messages about morality, danger, and sin. I look at specific manuscripts and illustrations to reveal the cultural values reflected in monster imagery. Since the Arthurian legend has many interpretations across cultures, I also compare how monstrous figures appear in different cultural stories. This helps me explore these legends' significance and how they shape ideas about heroism and morality. Then, I interpret monsters symbolically, looking at how they reflect societal fears and moral

lessons. I analyze the history of the word "monster" and what it means for past and present views on monstrosity. I participate in

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Fig: Harley MS 6563, ff 71v-72. The Art of the Ordinary: Marginalia as a Window into Medieval Culture - Retrospect Journal

archival research to explore visual materials and their cultural meanings. I use case studies of specific manuscripts or artistic interpretations to illustrate the

main themes of our research. By employing this comprehensive approach, we aim to uncover the complexities of medieval monsters, their cultural significance, and their relevance in modern folklore and mythology.

Discussion: This tradition shares ideas with ¹⁴humoralism, which was developed by the Greek doctor ¹⁵Hippocrates (circa 370 BCE). People believed climate could affect the balance of the ¹⁶Four Humours in the body. This idea helped explain why some creatures were seen as monsters and how religion connected them to their subhuman characteristics. These creatures were thought to be a twist on the perfect human body created in ¹⁷God's image, making them anatomically, morally, and spiritually inferior. Sadly, these ideas Figure 1: Medieval Maps and Marginalia: Monsters and

also influenced early concepts of race. ¹⁸Starting in



<u>Hidden Meanings – The Historians Magazine</u>

the mid-fifteenth century, Europeans began interacting with other cultures and used the belief that climate and humoral differences explained ethnic and cultural variations.

¹⁴ Medieval Maps and Marginalia: Monters and Hidden Meanings. Paragraph 2nd.

¹⁵ Medieval Maps and Marginalia: Monters and Hidden Meanings. Paragraph 2nd.

¹⁶Medieval Maps and Marginalia: Monters and Hidden Meanings. Paragraph 2nd.

¹⁷ Medieval Maps and Marginalia: Monters and Hidden Meanings. Paragraph 2nd.

¹⁸ Medieval Maps and Marginalia: Monsters and Hidden Meanings. Paragraph 2nd.



They justified seeing people from extreme climates as inferior. This notion is illustrated in the ¹⁹Map Psalter, a world map from the late thirteenth century.

²⁰At the bottom right of Africa are drawings of semi-human creatures, reflecting the belief that monsters lived in these far-off climates.²¹Jack Hartnell suggests that this belief is not so different from today's ideas about alien life in space. He points out that such views arise not from scientific evidence but from the same human impulses that shaped medieval ideas about monsters. ²²The Blemmyae, for example, show the blend of real and imagined bodies in medieval thought, revealing more about people's fears and hopes than about Africa itself. Hartnell also reminds us that medieval mapmakers were interested in showing historical and mythical figures and events just as much as they wanted to represent geography accurately. ²³As Perrone points out, medieval illustrations are still engaging, informative, and reflective of the beliefs and fears of the time. Marginalia refers to the edges of pages in medieval manuscripts. These edges often contain detailed illustrations and random doodles. They are vital because they provide insight into a book's history and the people who contributed to it from its creation to today. I find them fascinating, especially when they show killer bunnies. ²⁴Marginalia, the notes and drawings found in the margins of manuscripts, often have a clear purpose (Rossis,2027), but sometimes their meanings are hard to decipher. Many examples show unusual marginalia, like ²⁵monkeys playing bagpipes, centaurs, knights battling snails,

naked bishops, and strange humananimal hybrids (Rossis,2017). Some of these illustrations are just for funart for art's sake. There are also simple doodles²⁶ in the margins. While it may seem wrong to doodle on priceless books, people have been doing it for centuries. These doodles give us a glimpse into the experiences readers had with these books. ²⁷Adding glosses, biblical references, or commentary for medieval texts shows the reader engaged with the text. contrast, scribbles In



Figure 2: Atlas Obscura. <u>Medieval-Style Doodles, Marginalia,</u> <u>and Manicules | Nicholas C. Rossis</u>

(Rossis,2027) might indicate a scribe testing a new pen, while other marks can suggest a bored reader using blank spaces like scrap paper. This practice is like archaeology for books.

¹⁹ Medieval Maps and Marginalia: Monsters and Hidden Meanings. Paragraph 2nd.

²⁰ Medieval Maps and Marginalia: Monsters and Hidden Meanings. Paragraph 2nd.

²¹ Medieval Maps and Marginalia: Monsters and Hidden Meanings. Paragraph 2nd.

²² Medieval Maps and Marginalia: Monsters and Hidden Meanings. Paragraph 2nd.

²³ Medieval Maps and Marginalia: Monsters and Hidden Meanings. Paragraph 2nd.

²⁴ Medieval-Style Doodles, Marginalia, and Manicules. Artistic Marginalia. Paragraph 1st.

²⁵ Medieval-Style Doodles, Marginalia, and Manicules. Artistic Marginalia. Paragraph 1st.

²⁶ Medieval-Style Doodles, Marginalia, and Manicules. Doodling Away. Paragraph 1st.

²⁷ Medieval-Style Doodles, Marginalia, and Manicules. Doodling Away. Paragraph 1st.



One common form of annotation is the ²⁸manicule, a tiny hand symbol used as a highlighter. ²⁹A manicule looks like a hand with an outstretched index finger pointing to important text. While manicules are still seen in old signage and decor today, they were particularly popular in ³⁰medieval and Renaissance Europe (Rossis,2017). Though the first recorded use of a manicule is hard to identify, they were seen in the ³¹Domesday Book of 1066. Their widespread use began around the 12th century (Rossis,2017). The name comes from the Latin word ³²"manicula," meaning "little hand." Other names for the manicule include ³³bishop's fist, pointing hand, and digit. (Rossis,2017) The manicule functioned: ³⁴it pointed to significant text in the margins, serving as a medieval version of a highlighter. While mainly used by readers, scribes or printers sometimes added them to mark new sections. With the rise of printed books, the use of manicures changed. Publishers began highlighting important text more than readers did, using the margins to add notes or commentaries. ³⁵By the 19th century, manicules had moved beyond books to signs, advertisements, and posters, directing attention to important information. For example, a maniacule pointed to a reward announcement in the ³⁶"Wanted" poster for John Wilkes Booth after he assassinated President Lincoln. ³⁷Manicules even appeared on gravestones, pointing up toward heaven.

Conclusion

The legacy of medieval monsters, seen through manuscripts and maps, shows a rich mix of

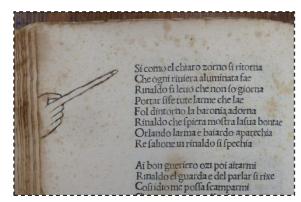


Figure 3: Atlas Obscura. Medieval-Style Doodles, Marginalia, and Manicules | Nicholas C. Rossi's

cultural meaning and artistic expression. These creatures often appear in the margins of texts and provide entertainment and warning symbols that reflect their time's fears and moral lessons. The connection between myth, culture, and the revival of classical texts during the Renaissance helped these fantastical beings remain in people's imaginations, linking ancient beliefs to modern interpretations. By looking at the marginalia and their stories, we can better understand the values and concerns of the medieval period.

- ³⁵ Medieval-Style Doodles, Marginalia, and Manicules. The Manicule's Descendants. Paragraph 1st.
- ³⁶ Medieval-Style Doodles, Marginalia, and Manicules. The Manicule's Descendants. Paragraph 1st.
- ³⁷ Medieval-Style Doodles, Marginalia, and Manicules. The Manicule's Descendants. Paragraph 1st.

²⁸ Medieval-Style Doodles, Marginalia, and Manicules. The Highlighter, aka, The Manicule. Paragraph 1st.

²⁹ Medieval-Style Doodles, Marginalia, and Manicules. The Highlighter, aka, The Manicule. Paragraph 1st.

³⁰ Medieval-Style Doodles, Marginalia, and Manicules. The Highlighter, aka, The Manicule. Paragraph 1st.

³¹ Medieval-Style Doodles, Marginalia, and Manicules. The Highlighter, aka, The Manicule. Paragraph 2nd.

³² Medieval-Style Doodles, Marginalia, and Manicules. The Highlighter, aka, The Manicule. Paragraph 2nd.

³³ Medieval-Style Doodles, Marginalia, and Manicules. The Highlighter, aka, The Manicule. Paragraph 2nd.

³⁴ Medieval-Style Doodles, Marginalia, and Manicules. The Highlighter, aka, The Manicule. Paragraph 3rd.



Ongoing interest in monsters inspires modern research, creative works, and a deeper understanding of our shared human experiences across different cultures and times. Ultimately, studying medieval monsters goes beyond simple curiosity; it encourages us to think about the complexities of our own stories about fear, morality, and the unknown.



Figure: An intricate manicule directs attention to the Virgin Mary and Jesus. The Latin phrase Ecce Ancilla Domini translates to Behold the handmaid of the Lord. Medieval-Style Doodles, Marginalia, and Manicules | Nicholas C. Rossis. Medieval-Style Doodles, <u>Marginalia, and Manicules | Nicholas C. Rossis</u> **CASIA PACIFIC** 11th INTERNATIONAL CONGRESS ON CONTEMPORARY SCIENTIFIC RESEARCH March 12-15, 2025 / Ho Chi Minh, Vietnam WEB: https://www.iksadasia.org/ E-MAIL: iksadasia@gmail.com



Figure - Pen tests of different letters in the margins of Life of Our Lady. Atlas Obscura. <u>Medieval-Style Doodles,</u> <u>Marginalia, and Manicules | Nicholas C. Rossis</u>





mee traimigra mmonteliepa





Hanging on via Atlas Obscura. <u>Medieval-Style Doodles, Marginalia, and</u> <u>Manicules | Nicholas C. Rossis</u>



ertoc

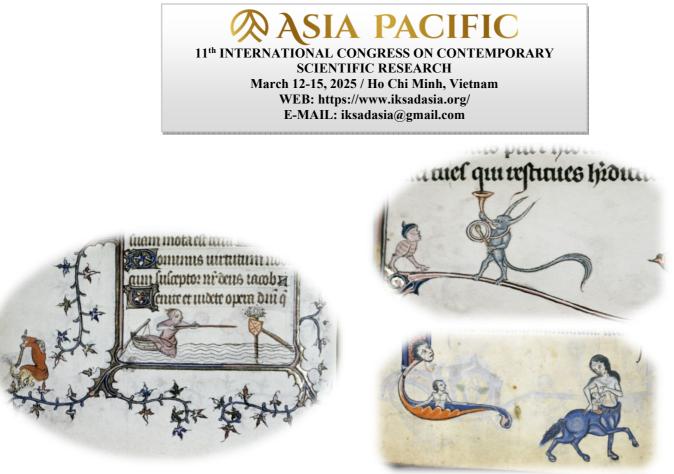


Figure 4: Monstrous Marginalia

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SUSTAINABLE URBAN DEVELOPMENT IN ASSOCIATION WITH THE CONSERVATION AND PROMOTION OF THE VALUE OF SOUTHERN VIETNAMESE ANCIENT HOUSES

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Abstract

Southern Vietnam is home to a rich collection of ancient houses that embody the region's historical and cultural heritage. However, the rapid pace of urbanization has posed significant threats to their value and long-term existence. Further research is necessary to explore sustainable urban development approaches that effectively balance modernization with the preservation of these historical architectural assets. This study examines the current state of ancient houses in Southern Vietnam within the context of urban expansion, identifying key challenges and proposing conservation strategies that align with sustainable development principles. By analyzing relevant literature and empirical data from cities and provinces in the region, the study advocates for sustainable preservation solutions, including the establishment of a legal framework and the enhancement of community engagement. The research recommends the designation of special conservation zones integrated with green urban planning to safeguard cultural heritage while accommodating contemporary urban demands. Additionally, public-private partnerships and support from international organizations are identified as crucial factors in ensuring a coordinated approach to development and the long-term preservation of Southern Vietnam's ancient houses.

Keywords: Sustainable Urban Development, Ancient Houses Preservation, Southern Vietnam, Heritage Conservation, Public-Private Partnerships.



REDESIGNING PUBLIC SPACES FOR RESILIENCE: THE ROLE OF SOCIAL RESEARCH IN POST-PANDEMIC URBAN PLANNING

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Abstract

The present of the Covid 19 pandemic has highlighted the important role of the public space in the making of social resilience, economic recovery and public health. Urban planners around the world are incorporating social research to help fit the inevitable post pandemic challenges to'redesign' public spaces. A community has to facilitate the participation of all its residents in the planning and development of an urban environment. This study thus looks specifically at the role played by participatory planning, data driven decision making, and community engagement in making urban environment resilient. Social research's adaptive urban strategies of creating more accessible, mobile and social cohesive cities are illustrated using case studies from the implementation of Melbourne's COVID Safe Outdoor Dining, New York City's Open Streets, and Paris' 15-Minute City. This research brings out the evidence based urban interventions needed to develop sustainable and inclusive cities from the parameters of mobility patterns, public health concerns, community preferences. These findings show that the combination of social research within planning leads to enhanced and future-proofing public spaces to face future global challenges.

Keywords: Public Space Resilience; Post-Pandemic Urban Planning; Social Research in Urban Design; Sustainable Urban Development; Urban Mobility and Accessibility.



OPEN VS. ENCLOSED SPACES: A PSYCHOLOGICAL ANALYSIS OF HOW SPATIAL DESIGN INFLUENCES SOCIAL INTERACTION

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Spatial design is a critical mechanism in the way people interact, how they communicate, how they collaborate and how they experience a particular mental state. This research analyzes in which way open and closed spaces influence the social behavior in workplaces, public spaces, and educational settings. While open spaces are linked to a higher amount of social engagement with one another, they may enable distraction and overstimulation. In contrast, enclosed spaces offer privacy, concentration, and facilitate deeper, more conversational conversations, as well as allowing for more specialized work where exchanging with others at random might be deleterious to a task. This research in the context of a psychological lens analyzes how spatial configurations influence user experience, and they highlighted the importance while paying attention to making both an interaction and a personal comfort balance. Case studies and existing literature indicate that the issues of designing for flexible and admissible spatial designs are to accommodate various social and cognitive needs. The message of the study is that psychological principles need to be integrated in architectural planning in order to design environments that facilitate productivity as well as social well-being. The future research directions are to seek hybrid space and digital environment that facilitate better understanding of evolving spatial dynamics in the world that is more and more interconnected.

Keywords: Spatial Design; Social Interaction; Open Spaces; Enclosed Spaces; Environmental Psychology.



SOCIAL RESILIENCE THROUGH PLACEMAKING: HOW ARCHITECTURE CAN ENHANCE COMMUNITY WELL-BEING

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Abstract

Social resilience is a prerequisite for sustainable urban development because it significantly impacts the capacity of communities to adapt to the social, economic and environmental problems. In this study, we explore how architectural design can improve community well being, thus enriching the process of placemaking, the to act of addressing place, peoples' needs and priorities, and of creating forms from those interactions that make place. The research studies various architectural strategies, and key ones among them are inclusive public spaces, participatory urban design and sustainable infrastructures, and based on that they work for better social bonds and better quality of life. Case studies of such case studies are presented in the transformation of Belfast's Peace Walls and Bilbao's revitalization through the Guggenheim Museum – as both factors of placemaking interventions that are able to mitigate the social fragmentation, promote cultural integration and enhance local economies. They signify the significance of community participation in planning the architecture: despite functional needs, only good spaces promote social cohesion and performative identity. Placemaking is hence represented as a strong tool to improve urban resilience through integrating context specific and adaptation design principles. It is of significance to the discourse on architecture and its contribution to shaping resilient cities, which will contribute to the process of shaping inclusive and sustainable communities for policymakers, architects as well as urban planners.

Keywords: Social Resilience; Placemaking; Community Well-being; Urban Planning; Sustainable Development.

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EĞİTİM KURUMLARINDA KADIN YÖNETİCİLERİN GÖZÜNDEN OKUL YÖNETİMİNDE KARŞILAŞILAN SORUNLAR ÜZERİNE YAPILAN ARAŞTIRMALARIN ANALİZİ

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ÖZET

Eğitim sektörü, toplumların kalkınmasında ve bireylerin potansiyellerini en üst düzeye çıkarmasında kritik bir rol oynar. Toplumun gelişimi ve bu gelişimin sürekliliğinin sağlanması eğitimin başlıca görevidir. Eğitim sektöründe kadın çalışanların sayısı erkek çalışanlara göre oldukça fazladır. Türkiye İstatistik Kurumu (TÜİK) verilerine göre, öğretmenlerin büyük bir kısmı kadınlardan oluşmaktadır. 2023 verilerine göre, Milli Eğitim Bakanlığı (MEB) bünyesinde çalışan öğretmenlerin yaklaşık %60'ı kadındır. Özellikle ilkokul ve ortaokul düzevindeki öğretmenlerin büyük bir kısmı kadındır. Avrıca UNESCO'nun verilerine göre, dünya genelinde öğretmenlerin yaklaşık %60'ı kadındır. Ancak, kadın öğretmenlerin sayısı genellikle eğitim sektörünün alt kademelerinde (ilk ve orta öğretim gibi) daha fazladır, üst düzey yönetim pozisyonlarında ise kadın temsili daha düsüktür. Bu verilere göre hem ülkemizde hem de dünvada kadın calısanların sayısının erkek calısanların sayısından fazla olan eğitim sektöründe dahi yönetimde olan kadınların sayısının çok az olduğu görülmektedir. Bu sonuçların ortaya çıkma sebebi kadın yöneticilerin eğitim kurumlarında karşılaştıkları sorunlardır. Cinsiyet temelli ayrımcılık, cam tavan sendromu, toplumsal cinsiyet rolleri nedeniyle karşılaştıkları ailevi sorumluluklar ve liderlik becerileri konusunda duydukları güvensizlik, kadınların eğitimdeki yönetim kademelerine yükselmesinin önündeki başlıca engellerdir. Bunun yanı sıra, kadın yöneticilerin karar alma süreçlerine katılımı, erkek egemen yönetim anlayışları ve eğitimdeki toplumsal cinsiyet esitsizlikleri gibi yapısal sorunlarla da kadın yöneticilerin karşılaştığı engeller arasındadır. Yapılan bu çalışmayla eğitim kurumlarında yer alan kadın yöneticilerin karşılaştığı engeller, yaşadığı sorunlar üzerine yapılan çalışmaların analizini yaparak bu sorunları somut hale getirmek ve çözüm önerileri sunmak amaçlanmıştır. Bu amaç doğrultusunda kadın yöneticilerin karşılaştığı sorunlar ve engeller ile ilgili yapılan çalışmalar türleri bakımından incelenmiştir. Bu sorunlar; bireysel sorunlar ve toplumsal sorunlar olarak kategorize edilmiş ve alt başlıkları sıralanmıştır. Araştırmada nitel araştırma yöntemlerinden biri olan doküman analizi kullanılmıştır. Araştırmada kadın yöneticilerin karşılaştığı sorunları farklı türlerde ele alan tez çalışmalarının verileri incelenmiştir. Veriler, tez arama ve metaveri analizi aracı olan tezara.org sitesinden elde edilmiştir. Veriler, "Kadın, Yönetici, Okul, Engeller, Sorunlar" anahtar kelimeleri kullanılarak süzülmüştür. Elde edilen veriler içerik analizi yöntemi ile analiz edilmiştir. Araştırmanın sonucunda, kadın yöneticilerin karşılaştığı sorunların en fazla cam tavan sendromu, cinsiyet eşitsizliği, kadınların benlik algısı, kadınların eş-anne sorumlulukları, toplumsal cinsiyet rolleri, medeni durum, yaş ile ilişkilendirilerek araştırıldığı tespit edilmiştir.



Araştırmalar çoğunlukla nitel araştırma yöntemleriyle yapılmış ve yarı yapılandırılmış görüşme formu kullanılarak yüz yüze görüşmeler yapıldığı görülmüştür. Kadın yöneticilerin karşılaştıkları sorunlar ile ilgili yapılacak sonraki çalışmalarda bu sorunların çözümü için somut adımları atabilecek konumda olan kişilerle görüşmeler yapılabilir, çalışmaya bu kişiler dahil edilebilir.

Anahtar Kelimeler: Kadın yöneticilerin karşılaştıkları sorunlar, engeller, bireysel sorunlar, toplumsal sorunlar.

AN ANALYSIS OF RESEARCH ON THE CHALLENGES FACED IN SCHOOL MANAGEMENT FROM THE PERSPECTIVE OF FEMALE ADMINISTRATORS IN EDUCATIONAL INSTITUTIONS

ABSTRACT

The education sector plays a pivotal role in the development of societies and the enhancement of individual potential. Ensuring societal progress and its sustainability is a primary responsibility of the education system. The number of female employees in the education sector is significantly higher than that of male employees. According to data from the Turkish Statistical Institute (TÜİK), a substantial proportion of teachers are women. As of 2023, approximately 60% of teachers employed by the Ministry of National Education (MEB) are women. A significant proportion of teachers, particularly at the primary and secondary school levels, are women. Furthermore, according to UNESCO data, approximately 60% of teachers worldwide are women. However, while the number of female teachers is higher in the lower levels of education (such as primary and secondary education), the representation of women in senior management positions remains disproportionately low. These findings indicate that, even in the education sector, where the number of female employees exceeds that of male employees both in Turkey and globally, the proportion of women in leadership roles remains markedly low. This discrepancy is attributed to the barriers faced by female administrators in educational institutions. Gender-based discrimination, the glass ceiling syndrome, family responsibilities resulting from gender roles, and a lack of self-confidence in leadership abilities are among the primary obstacles hindering women's advancement to senior management positions in education. Additionally, structural challenges, such as patriarchal management structures and gender inequality in educational settings, further constrain the participation of female administrators in decision-making processes.

This study aims to analyze the barriers encountered by female administrators in educational institutions by reviewing existing research on the challenges they face, thereby making these issues more tangible and proposing potential solutions. In pursuit of this goal, studies addressing the problems and barriers faced by female administrators were examined and categorized into individual and societal issues. The research employed document analysis, a qualitative research method. The data were gathered from theses that explore the various issues faced by female administrators. These data were accessed via the thesis search and metadata analysis platform, tezara.org, using keywords such as "Women, Manager, School, Barriers, Issues." The collected data were subjected to content analysis. The results of the analysis indicate that the most prevalent challenges faced by female administrators include the glass ceiling syndrome, gender inequality, self-perception of women, familial responsibilities (as spouses and mothers), gender roles, marital status, and age-related factors. Most of the studies reviewed utilized qualitative research methods, and face-to-face interviews were conducted using semi-structured interview protocols.



Future research on the challenges faced by female administrators could include interviews with individuals in positions to implement concrete solutions to these issues, thereby incorporating these stakeholders into the research.

Keywords: Barriers faced by female administrators, challenges, individual issues, societal issues

1. GİRİŞ

Kadınların yönetim kademelerinde çok az sayıda olmaları ve erkeklere göre daha fazla engel ve sorunlarla karşılaşmaları yalnızca ülkemizde değil tüm dünya ülkelerinde görülen bir durumdur denilebilir. Tarihsel olarak da yapılan çalışmalar incelendiğinde kadınların yönetim kademelerindeki varlıkları görmezden gelinmiş, sayı olarak da varlıklarını erkeklere göre gösterememişlerdir. Peki kadınların yönetim alanında kendilerini yeterince temsil edememelerinin sebebi nedir? Kadınların yönetim kademelerinde olamamalarının sebebi erkeklerin kadınlar ile ilgili bakış açıları mıdır? Yoksa kadınların kendilerine yeterince görenmemeleri ya da sorumluluk almakla ilgili çekinceleri midir? Kadınların anne-eş sorumluluklarını kariyerlerinden önde tutmaları mıdır? Bu sorular birçok araştırmacının cevabını bulmak için yola çıktıkları sorulardır.

Kadınların yaşadığı bu sorunlar sebebiyle birçok çalışmalar yapılmıştır. Ancak bu çalışmalara rağmen sorunları çözme konusunda belirgin yollar katedilmemiş denebilir. Türkiye İstatistik Kurumu 2018 verilerine göre 2017 yılında Türkiye'de kamu sektöründeki üst düzey yönetici pozisyonlarındaki kadınların oranının %16,7 olduğunu göstermektedir (TUİK, 2018). Bu yüzde 2023 yılındaki TUİK verilerine göre üst ve orta düzey yönetici pozisyonundaki kadın oranı %19,6 olduğunu göstermektedir. (TUİK, 2023). Verilere bakıldığında 5 yıllık süreçte %2,9'luk bir artışın olduğu görülüyor. Ancak bu oranın yeterli olmadığı söylenebilir.

Kadınların erkeklerden daha fazla olduğu eğitim sektöründe bile eğitim yöneticiliği kademesinde kadınların bariz daha az olduğu görülmektedir. Bu konuda Milli Eğitim Bakanlığı kadın yöneticileri destekleyen çalışmalar da yapmıştır. Her okulda görev yapan müdür yardımcılarından mutlaka bir tanesinin kadın olması gerektiği gibi kadın yöneticileri destekleyen planlamalar yapılmıştır. Buna rağmen eğitim sektöründe de diğer sektörlerde olduğu gibi kadınların yönetim kademelerindeki varlığı çok çok azdır denilebilir.

Bu çalışmada, yukarıda soruları konu almış 15 adet yüksek lisans ve doktora tezleri incelenmiştir.

1.2. Araştırmanın Problemi

Çalışmanın problemi, kadın yöneticilerin özellikle eğitim sektöründe karşılaştığı sorunlarla ilgili yapılan çalışmalarda ortaya konan sonuçlar nelerdir? Bu sorunlar hangi başlıklarla ifade edilmiştir? Saptanan sorunlarla ilgili çözüm önerileri nelerdir?

1.2.1 Araştırmanın Alt Problemleri

a) Kadın yöneticilerin karşılaştığı bireysel sorunlar alt temasında ele alınan sorunlar nelerdir?

b) Kadın yöneticilerin karşılaştığı toplumsal sorunlar alt temasında ele alınan sorunlar nelerdir?

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2. YÖNTEM

Çalışmada kullanılan yöntem nitel araştırma yöntemlerinden biri olan doküman analizidir. Doküman analizi, yazılı belgelerin içeriğini titizlikle ve sistematik olarak analiz etmek için kullanılan bir nitel araştırma yöntemidir (Wach, 2013).

Yapılan araştırmada konu ile ilgili derinlemesine bir araştırma yapılmak istenmesinden özellikle eğitim sektöründe görev yapan kadın yöneticileri konu alan araştırmalar seçilmiştir. Araştırma evrenini ilgili anahtar kelimeler doğrultusunda eğitim alanında kadın yöneticilerin karşılaştığı sorunları ele alan 15 adet yüksek lisans ve doktora tezleri oluşturmaktadır.

Araştırma verileri, tez arama ve metaveri analizi aracı olan tezara.org sitesinden elde edilmiştir. Veriler, "Kadın, Yönetici, Okul, Engeller, Sorunlar" anahtar kelimeleri kullanılarak süzülmüştür. Elde edilen veriler içerik analizi yöntemi ile analiz edilmiştir. İçerik elde edilen tezler resmi sitesinden ve tez kodlarıyla elde edildiğinden geçerliliği ve güvenirliği yüksektir denilebilir.

3. BULGULAR

Bu bölümde alt problemler kadın yöneticilerin yaşadığı sorunlar alt problemlere göre bireysel sorunlar ve toplumsal sorunlar alt başlıklarına göre incelenmiştir.

3.1 Kadın Yöneticilerin Karşılaştığı Bireysel Sorunlar Alt Temasında Ele Alınan Sorunlar

3.1.1 Cam Tavan Sendromu: Cam tavan sendromu basit olarak kişilerin karşısına çıkan problemlerin somut olarak görülmemesi ancak hissedilmesi olarak ifade edilebilir. İncelenen çalışmalara göre kadın yöneticiler yönetici olduktan kendi kendilerine psikolojik olarak bazı engeller koydukları görülmüştür. Kadınların benlik algısındaki bazı aksaklıklar, yöneticilikte mükemmelliyetçiliği aramaları, stres, birden fazla işe aynı anda yetişmeye çalışmak, kendilerini diğer yöneticilerle karşılaştırmak gibi durumlar örnek verilebilir.

3.1.2 Özgüven Eksikliği: Kadın yöneticilerin özgüven eksikliği yaşamasının temelinde toplumsal cinsiyet rolleri, önyargılar ve cam tavan sendromu gibi faktörler bulunmaktadır. Geleneksel olarak liderlik pozisyonlarının genellikle erkeklere özgü bir pozisyon olduğunun düşünülmesi kadınların kendilerini daha güçsüz ve yetersiz hissetmelerine sebep olmaktadır. Kadınların yaratılışları bakımından daha duygusal olmaları, kurallara bağlı ve mükemmelliyetçiliğe yatkın olmaları onların erkek yöneticilerle karşılaştırılmasına, yöneticilik tarzlarının eleştirilmesine ve sorgulanmasına yol açmaktadır. Bu durum yine kadın yöneticilerde özgüven sorunları oluşmasına sebep olmaktadır.

3.1.3 Başarısızlık- Yalnızlık Korkusu: Kadın yöneticilerin okul yönetiminde karşılaştıkları zorluklardan biri, "Başarısızlık- Yalnızlık Korkusu" olarak tanımlanabilir. Bu korku, kadınların liderlik rollerinde başarılı olamayacaklarına dair duydukları endişe ve yalnızlık hissiyle birleşen bir deneyimdir. Kadın liderlerin, erkek egemen bir toplumda ve okul yönetiminde daha az temsil edilmeleri, bu korkunun güçlenmesine yol açmaktadır. Toplumsal cinsiyet normları ve beklentileri, kadınların liderlik rollerine ilişkin algıları şekillendirirken, onları daha fazla sınavdan geçirmekte ve kendilerini izole hissetmelerine neden olabilmektedir.

Başarısızlık korkusu, kadın yöneticilerin sürekli olarak yüksek performans göstermeleri gerektiği baskısını yaratırken, yalnızlık korkusu da karar alma süreçlerinde daha az destek almalarına ve yalnızca kendi başlarına mücadele etmelerine yol açabilir. Bu durum, liderlik tarzlarını etkileyebilir, daha az risk almalarına ve yenilikçi yaklaşımlar geliştirmelerine engel olabilir. Ayrıca, kadın yöneticilerin başarısızlık korkusu, duygusal ve psikolojik olarak tükenmişlik hissine neden olabilir.



3.2 Kadın Yöneticilerin Karşılaştığı Toplumsal Sorunlar Alt Temasında Ele Alınan Sorunlar

3.2.1 Kadınlara Yönelik Kalıp Yargılar: Kadınların toplumda liderlik pozisyonlarına gelmelerindeki en büyük engellerden biri, toplumsal cinsiyet kalıp yargılarıdır. Toplumda kadınların "duygusal", "anne", "güçsüz" gibi kalıplarla sınırlandırılması onların yönetim posizyonlarındaki varlığını, liderlik vasıflarını sorgulamaya yol açmaktadır denilebilir.

3.2.2 Anne-Eş Rolü: Kadınlar, anne ve eş rolü ile birlikte profesyonel hayatta liderlik yapma rolünü birleştirmek zorunda kaldıklarında önemli bir çatışma yaşarlar. Bir yandan toplum kadınların ailesine karşı sorumluluklarını yerine getirmesini beklerken diğer yandan profesyonel başarıları konusunda bazı ödünleri vermesi gerektiğini düşünür. Ancak aynı durum erkekler açısından tam tersidir. Erkeklerin profesyonel yaşamları eşleri tarafından desteklenmesi gerektiği düşünülür.

3.2.3 Cinsiyete Dayalı Önyargı: Cinsiyete dayalı önyargılar, kadınların iş dünyasında daha düşük statüde yer almalarına yol açan bir diğer önemli engeldir. Kadınların liderlik vasıfları erkek egemez bakış açıları sebebiyle toplumda önemsenmez denebilir. Kadınların karar alma kapasiteleri, liderlik özellikleri, duygusal sağlamlıkları erkeklere göre daha zayıf algılanarak yöneticilik pozisyonlarına uygun görülmediği söylenebilir. Bu durum da kadınların yöneticilikte karşılarına çıkan önemli engellerden birisidir.

3.2.4. Kraliçe Arı Sendromu: Kadınların diğer kadınların kariyer gelişimlerine engel olma eğiliminde olmalarını tanımlar. Bu sendrom, genellikle erkek egemen ortamlarda bir kadının liderlik pozisyonuna yükseldiğinde, diğer kadınları rekabet olarak görmesi ve onlara zarar vermesi şeklinde tezahür eder. Kraliçe arı sendromu hem bireysel hem de toplumsal engeller arasında sayılabilir. Yapılan araştırmalara göre kadınlar birbirlerini erkeklerin de olduğu yönetim kademelerinde desteklemeleri yineri rakip olarak görerek işlerini daha da zorlaştırdıkları sonucu çıkarılabilir.

3.2.5. Toplumsal Baskı ve Tutum: Kadınların yönetim pozisyonlarına ulaşmalarındaki zorluklardan bir diğeri, toplumsal baskılar ve kadınlara yönelik olumsuz tutumlardır. Kadınlar iş dünyasında bu baskılar sebebiyle erkeklere göre daha çaba sarf etmek zorunda kaldıkları söylenebilir. Kadınlara atfedilen aileyi ön planda tutma, duygusal olma, anne rolü gibi durumlar kadınların iş hayatında baskılandığı ve özellikle yönetim kademesi gibi daha fazla zaman ve emek gerektiren pozisyonlarda olmalarını gereksiz görebilmektedir denebilir.

SONUÇ, TARTIŞMA VE ÖNERİLER

Eğitim sektörü, toplumların kalkınmasında ve bireylerin potansiyellerini en üst düzeye çıkarmasında merkezi bir rol üstlenmektedir. Ancak, sektörde kadınların temsili ile ilgili olarak önemli bir dengesizlik söz konusudur. Türkiye İstatistik Kurumu (TÜİK) ve UNESCO verilerine göre, öğretmenlerin büyük bir kısmı kadınlardan oluşmakla birlikte, yönetim pozisyonlarında kadınların temsili oldukça düşüktür. Bu durum, eğitim sektöründeki kadınların yönetimdeki yerini sınırlayan engelleri gözler önüne sermektedir.

Kadınlar okul yönetiminde birçok sorunla karşılaşmakta ancak öne çıkanlar toplumsal cinsiyet rolleri, kadınlara yönelik kalıp yargılar, toplumsal baskı ve anne-eş rolü denilebilir. Kadınlar erkeklerin hiç karşılaşmadığı bu sorunlarla başa çıkıp aynı zamanda yönetim konusunda erkekler kadar başarılı olmak için daha fazla emek sarf etmek zorunda kaldıkları söylenebilir.

Yapılan bu araştırma okul yönetiminde kadın yöneticilerin karşısına çıkan engelleri bireysel engeller ve toplumsal engeller olarak iki kategoride incelemiştir.



Buna göre bireysel engeller bakımdan kadın yöneticilerin öncelikle benlik algılarının sağlamlaştırılması konusunda çalışmalar yapılması gerekmektedir. Kadın yöneticilerin güçlü ve zayıf yönlerini objektif olarak görebilecekleri ve bu konuda kendilerini geliştirebilecekleri alanlar oluşturulabilir. Yöneticilik konusunda eğitimler yapılarak bilgi birikimleri arttırılarak özgüven geliştirmeleri sağlanabilir. Toplumsal engeller konusunda yapılabilecekler çok fazla olsa da toplumun algısını değiştirmek kolay bir iş değildir ve çok uzun zaman alabilir. Ancak yine de yönetim kademelerinde üst pozisyonlarda yer alan yöneticilerin kadın yöneticileri desteklemeleri bu konuda atılacak önemli adımlardan biri olabilir. Kız çocuklarının çok küçük yaşlardan itibaren liderlik özellikleri desteklenebilir.

Bu analiz, okul yönetiminde kadın yöneticilerin karşılaştığı sorunlar ve engelleri derinlemesine araştırmak için yapılmıştır. Bu sorunlar ve engellerin aşılması için yapılacak çalışmalar için çözüm önerileri geliştirilmiştir.

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ÖĞRETMENLERİN ÖRGÜTSEL UYUMU ÜZERİNE YAPILAN ARAŞTIRMALARIN ANALİZİ

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ÖZET

Bu çalışmanın amacı, öğretmenlerin örgütsel uyumu üzerine yapılan çalışmaların çözümlemesini yaparak ilgili alanyazınına tavsiyelerde bulunmaktır. Bu amaca ulaşmak için, öğretmenlerin örgütsel uyumu ile ilgili olan çalışmalar konuları, yayınladıkları yıllar ve hangi tür yayın oldukları yönlerinden incelenmiştir. Nitel araştırma metotlarından bir tanesi olan doküman incelemesi bu çalışmada kullanılmıştır. Çalışmada aktüel bilgilere ulaşılmak hedeflendiğinden, 2014-2024 yılları arasında yürütülen tez çalışmaları ile yine bu süreçte yazılan makalelerin verileri analiz edilmiştir. Analize tabi tutulan verilerin elde edilmesinde kullanılan veri tabanları YÖK Ulusal Tez Veri Merkezi ve Google Akademik'tir. Veri toplama aşamasında, bahsedilen veri tabanlarında tarama yapılırken "öğretmenlerin örgütsel uyumu" anahtar kelimelerinden yararlanılmıştır. Toplanılan verilerin analizinde kullanılan metot içerik analizidir. Araştırmanın neticesinde öğretmenlerin örgütsel uyumu ile ilgili yapılan çalışmaların örgütsel sessizlik, örgütsel dışlanma, okul müdürlerinin koçluk rolleri, okul müdürlerinin mentorluk fonksiyonları, mesleki idealizm, örgütsel sosyalleşme ve örgütsel adalet ile ilişkilendirilerek çalışılmış olduğu; çalışmaların en çok 2022 ve 2023 yıllarında yürütülmüş olduğu, çalışmaların yayın türü olarak dağılımında makale ve yüksek lisans tezlerinin çoğunlukta olduğu ve çalışmalarda en fazla nitel araştırma tekniklerinin kullanıldığı bulgularına ulaşılmıştır. Öğretmenlerin örgütsel uyumu konusunda yapılacak sonraki araştırmalarda örgütsel uyum konusunun ilişkilendirildiği konuların çeşitliliğinin arttırılması, örgütsel uyumun daha geniş bir perspektiften incelenmesine katkı sağlayabilir. Ayrıca; öğretmenlerin örgütsel uyum durumlarını yaş, cinsiyet, okul türü ve kademesi, devlet okulu veya özel okulda çalışma durumları gibi farklı kriterlerle inceleyen araştırmalar da yürütülebilir.

Anahtar Kelimeler: Öğretmenlerin örgütsel uyumu, mesleki idealizm, örgütsel sosyalleşme

ANALYSIS OF STUDIES ON TEACHERS' ORGANIZATIONAL FIT

ABSTRACT

The purpose of this study is to analyze the researches conducted on teachers' organizational fit and provide recommendations for the relevant literature. To achieve this purpose, studies related to teachers' organizational fit have been examined in terms of the topics they are associated with, the years they have been published, and the types of publications they are. One of the qualitative research methods, document analysis, has been used in this study. Since the study tires to reach current information, the data from thesis works conducted between 2014-2024 and the articles written during the aforementioned period have been analyzed.



The databases used to obtain the data subjected to analysis are the YÖK National Thesis Data Center and Google Scholar. During the data collection phase, the keyword "teachers' organizational fit" was used while scanning the mentioned databases. The method used in the analysis of the collected data is content analysis. As a result of the research, it was found that studies on teachers' organizational fit have been related to organizational silence, organizational exclusion, the coaching roles of school principals, the mentoring functions of school principals, professional idealism, organizational socialization, and organizational justice; that most of the studies have been conducted in 2022 and 2023; that the majority of the studies have been articles and master's theses; and that qualitative research techniques have been predominantly used in the studies. In future research on teachers' organizational fit, increasing the diversity of topics related to organizational fit could contribute to examining organizational fit from a broader perspective. Additionally, research examining teachers' organizational fit statuses using different criteria such as age, gender, type and level of school, and whether they work in public or private schools can also be conducted.

Keywords: Teachers' organizational fit, professional idealism, organizational socialization

1. GİRİŞ

Öğretmenlerin örgütsel uyumu, eğitim faaliyetlerinin yürütüldüğü örgütler olan okullar açısından büyük önem arzetmektedir. Çoğunlukla, bir kişinin çalıştığı kurumla bütünleşmesi, o kurumla ortak amaç ve değerleri paylaşması ve o kurum için çaba harcamaya gönüllü olması örgütsel uyum olarak tanımlanır (Çalık, 2003). Örgütsel davranış bilim dalı ise örgütsel uyumu, çalışanların değerleri ile işletmenin değer sistemi olan örgüt kültürü arasındaki ilişki olarak tanımlar. (Yahyagil, 2005). İşletme alanında çok çalışılmış bir konu olan örgütsel uyum, eğitim yönetimi alanında son yıllarda calısılmaya başlanmıştır. Öğretmenlerin örgütsel uyumları mesleklerine ve kurumlarına bağlılıklarını ve motivasyonlarını arttırabilmekte; bu gelişmelerin sonucu olarak akademik başarıyı, dolayısıyla da kurum kültürünü olumlu yönde etkileyebilmektedir. Öğretmenlerin örgütsel uyumu ile ilgili yapılan çalışmalara bakıldığında, örgütsel uyum konusunun örgütsel sosyalleşme, örgütsel sessizlik, mesleki idealizm, okul müdürlerinin koçluk rolleri ve okul müdürlerinin mentorluk fonksiyonları gibi örgütle ilgili diğer birçok konuyla birlikte çalışıldığı görülmektedir. Eğitim bilimleri alanında son yıllarda çalışılmaya başlanan bir konu olan örgütsel uvum konusunun kısa sürede örgütle ilgili bircok konuyla birlikte calısılması, örgütsel uyumun işgörenler, dolayısıyla örgüt için önemli bir konu olduğunu göstermektedir. Bu çalışma öğretmenlerin örgütsel uyumu ile ilgili yapılan çalışmaların çözümlemesini yapıp alanyazına tavsiyeler getirmeyi hedeflemektedir.

1.2 Araştırmanın Problemi

Çalışmanın problemi, öğretmenlerin örgütsel uyumu ile ilgili yapılan çalışmalar neler ile ilişkilendirilmiştir, öğretmenlerin örgütsel uyumu ile ilgili yapılacak çalışmalar hangi konularla ilişkilendirilirse örgütlere olumlu katkı sağlar olarak belirlenmiştir.

1.2.1 Araştırmanın Alt Problemleri

a) Öğretmenlerin örgütsel uyumu hakkında yürütülen çalışmaların ilişkilendirildikleri konular açısından dağılımı nasıl görünmektedir?

b) Öğretmenlerin örgütsel uyumu hakkında yürütülen çalışmaların yayınlandıkları yıllar açısından dağılımı nasıl görünmektedir?

c) Öğretmenlerin örgütsel uyumu hakkında yürütülen çalışmaların yayın türleri açısından dağılımı nasıl görünmektedir?



2. YÖNTEM

Bu araştırmada yöntem olarak nitel araştırma yöntemlerinden birisi olan doküman incelemesinden faydalanılmıştır. Doküman incelemesi, belirli bir hedef doğrultusunda dökümanları bulmayı, okumayı, not tutmayı ve bu işlemlerin muhakemesini içeren bir süreçtir. (Karasar, 2005). Başka şekilde ifade etmek gerekirse doküman incelemesi dijital veya basılı kaynakların çözümlenmesi ve muhakemesi sürecinde hayata geçirilen çalışmalar bütünüdür. (Bowen, 2009). Bu çalışmada da elektronik ortamda erişilebilen tez ve makale gibi eserlerin verileri incelenmektedir. Aktüel bilgilere ulaşılmak hedeflendiğinden, 2014-2024 yılları arasını kapsayan periyotta yürütülen tez calısmaları ve makalelerin verileri çözümlenmektedir. Araştırma evreni, 2014-2023 yılları arasında öğretmenlerin örgütsel uyumuna ilişkin yazılmış makaleler ve yürütülmüş tez çalışmalarından oluşmaktadır. Arastırmada, 2014-2024 perivodunda ortava konulan 10 adet calısma incelenmektedir. Araştırmadaki verileri toplamada faydalanılan veri tabanları YÖK Ulusal Tez Merkezi ve Google Akademik olup, bahsi geçen veri tabanlarında tarama yaparken kullanılan anahtar kelimeler "öğretmenlerin örgütsel uyumu" anahtar kelimeleridir. Bahsi geçen veri tabanlarından elde edilen veriler içerik analizi yöntemi ile çözümlenmiş olup, çözümlenen çalışmalar resmi web sitelerinden alındığından geçerlik ve güvenirliklerinin yüksek olduğunu söylemek mümkündür.

3. BULGULAR

Bu kısımda, araştırmanın alt problemleri doğrultusunda öğretmenlerin örgütsel uyumu ile ilişkilendirilmiş çalışmaların konu başlıkları, yayın türleri ve yayın yıllarının çözümlemesi yapılmış, çözümleme sonucunda elde edilen bulgular belirtilmiştir. Elde edilen bulgular; konu başlıkları, yayın yılları ve yayın türlerini gösteren tablolar şeklinde sunulmuştur.

3.1 Öğretmenlerin Örgütsel Uyumu Hakkında Yapılan Araştırmaların İlişkilendirildiği Konu Temelli Dağılımı

Araştırmalar sonucunda öğretmenlerin örgütsel uyumu ile ilgili yapılan araştırmaların ilişkilendirildiği konulara göre dağılımına bakıldığında; öğretmenlerin örgütsel uyumu konusunun örgütsel sessizlik, örgütsel dışlanma, okul müdürlerinin koçluk rolleri, okul müdürlerinin mentorluk fonksiyonları, mesleki idealizm, örgütsel sosyalleşme ve örgütsel adalet ile ilişkilendirilerek araştırılmış olduğu tespit edilmiştir. Öğretmenlerin örgütsel uyumu üzerine yapılan araştırmaların konularına göre dağılımına ait bilgiler Tablo 1'de gösterilmiştir. Tablo 1'de görülebileceği gibi, öğretmenlerin örgütsel uyumu hakkında yapılan araştırmalardan başka bir konuyla ilişkilendirilmeyen 3 araştırmada, öğretmenlerin örgütsel uyumu konusu genel olarak ele alınmıştır.



Tablo 1. Öğretmenlerin örgütsel uyumu üzerine yapılan araştırmaların ilişkilendirildikleri konu temelli dağılımı

Konu	F
Örgütsel Sessizlik	1
Örgütsel Dışlanma	1
Okul Müdürlerinin Koçluk Rolleri	1
Okul Müdürlerinin Mentorluk Fonksiyonları	1
Mesleki İdealizm	1
Örgütsel Sosyalleşme	1
Örgütsel Adalet	1
Öğretmenlerin Örgütsel Uyumu (Genel)	3

3.2 Öğretmenlerin Örgütsel Uyumu Hakkında Yapılan Araştırmaların Yayın Türü Temelli Dağılımı

Tablo 2'de incelenen araştırmaların yayın türlerine göre dağılımı verilmiştir. Araştırma sonucuna göre, 2014-2024 yılları arasında öğretmenlerin örgütsel uyumu üzerine yapılan 10 adet çalışma bulunmaktadır. Bu çalışmalar, yayın türü olarak bakıldığında 4 adet yüksek lisans tezi ve 6 adet bilimsel makale şeklinde bir dağılım göstermektedir.

Tablo 2. Öğretmenlerin örgütsel uyumu hakkında yapılan çalışmaların yayın türü temelli

dağılımı.

2014-2024	Makale	Tez (Yüksek Lisans)
f	6	4

3.3 Öğretmenlerin Örgütsel Uyumu Hakkında Yapılan Çalışmaların Yıl Temelli Dağılımı

Öğretmenlerin örgütsel uyumu hakkında yürütülmüş ve bu çalışmada çözümlenmiş araştırmaların yıl temelli dağılımına Tablo 3'te yer verilmiştir. Tablo 3'te 2014-2024 periyodunda yayınlanmış, öğretmenlerin örgütsel uyumu hakkında yürütülmüş yüksek lisans tezleri ve yazılmış bilimsel makaleler görülebilmektedir. İncelenen çalışmalara bakıldığında öğretmenlerin örgütsel uyumu ile ilgili 2014, 2019, 2021, 2022, 2023 ve 2024 yıllarında birer adet olmak üzere toplam 6 adet bilimsel makale yayınlandığı görülmektedir. 2014, 2018, 2022 ve 2023 yıllarında ise, öğretmenlerin örgütsel uyumu ile ilgili 4 adet yüksek lisans tezi yayınlandığı görülmektedir. 2015, 2016, 2017 ve 2020 yıllarında herhangi bir çalışmaya rastlanılmamıştır.

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 Tablo 3. Öğretmenlerin örgütsel uyumu hakkında yapılan çalışmaların yıl temelli dağılımı

İncelenen	Sayıların Makale	Tez (Yüksek Lisans)	6
Yayınlandığı Yıl			
2014			
f	1	1	
2018			
f	-	1	
2019			
f	1	-	
2020			
f	-	-	
2021			
f	1	-	
2022			
f	l	l	
2023			
<i>f</i>	1	I	
2024	1		
	<u> </u>	-	

4. SONUÇ, TARTIŞMA VE ÖNERİLER

Araştırma sonucunda öğretmenlerin örgütsel uyumu hakkında yürütülen çalışmaların ilişkilendirildikleri konu temelli dağılıma bakıldığında; örgütsel sessizlik, örgütsel dışlanma, okul müdürlerinin koçluk rolleri, okul müdürlerinin mentorluk fonksiyonları, mesleki idealizm, örgütsel sosyalleşme ve örgütsel adalet ile ilişkilendirilerek araştırılmış olduğu görülmektedir. Öğretmenlerin örgütsel uyumu hakkında yürütülen çalışmaların yayın türü temelli dağılımında ise makale türünün daha fazla olduğu göze carpmaktadır. Öğretmenlerin örgütsel uyumu üzerine yapılan çalışmaların yıl temelli dağılımına bakıldığında ise 10 çalışmanın 6'sının 2021-2024 yılları arasında yapıldığı görülmektedir. Öğretmenlerin örgütsel uyumu üzerine yapılacak sonraki çalışmalarda, örgütsel uyum konusunun ilişkilendirildiği konuların çeşitliliğinin arttırılmasının, konuya daha geniş bir perspektiften bakılması açısından önemli olacağı düşünülmektedir. Bir eğitim örgütü olan okullarda öğretmen-okul idaresi ilişkisinin sadece okul müdürü ile sınırlı kalmadığı göze çarpmaktadır. Öğretmenlerin örgütsel uyumunda okulun idari yönetim kadrosunda bulunan diğer idareciler (müdür başyardımcısı, müdür yardımcısı) ve diğer işgörenlerin de etkili olabileceği kestirilmektedir. Bu sebeple öğretmenlerin örgütsel uyumunun, daha geniş bir örneklemde incelenmesinin konuyla ilgili daha net bir resim çizilmesine olanak sağlayacağı öngörülmektedir. Öğretmenlerin örgütsel uyumu konusu incelenirken sonraki çalışmalarda öğretmenlerin yaş, cinsiyet, okul türü ve kademesi, devlet okulunda veva özel okulda calısma durumları gibi örgütsel uyuma etki edebilecek değişkenleri de içeren çalışmaların yapılması, örgütsel uyum konusunun çok boyutlu olarak ele alınmasını yardımcı olabilir.

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AN INVESTIGATION OF GIFTED ADOLESCENTS' SOCIAL MEDIA HABITS

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ABSTRACT

Developments in information and communication technologies have led to profound changes in communication patterns. Individuals now extensively use social media platforms to establish social relationships and provide social support (Karakuş & Tarhan, 2023). Adolescence, in particular, is a critical period for developing social relationships (Uzamaz, 2000) and gaining social support through these relationships (Erikson, 1968). During this stage, social media platforms have become an integral part of social life for individuals (Connolly, 2018). According to the 2024 report by the Turkish Statistical Institute (TÜİK), 79% of adolescents use social media platforms (TÜİK, 2024). This rate highlights the importance of examining adolescents' social media usage habits. In particular, considering that gifted adolescents use social media to support their social relationships with peers, meet their high need for information, and express themselves more comfortably, investigating their social media habits becomes even more significant. In this context, this study aims to deeply examine the social media usage habits of gifted adolescents. The research was designed using a case study, one of the qualitative research models, and data were collected through semistructured interviews. As part of the study, semi-structured interviews were conducted with 18 gifted adolescents aged 12-18, and content analysis was employed to analyze the data. The analyzed data were categorized under four main themes: social media habits, following trends, perception of influencers, and adverse experiences. Each theme includes categories and subcategories. The findings of the study reveal that gifted adolescents primarily perceive social media platforms as spaces for sharing, use them to acquire information, check their social media accounts every 2-3 hours, and spend 1-2 hours per day on social media. They also prioritize following accounts that are developmental, view influencers as individuals who promote products, consider a high number of likes and followers as indicators of influence, and describe understanding the target audience well as an influencer strategy. Additionally, gifted adolescents most frequently define their negative experiences on social media as receiving inappropriate comments and report using blocking as a coping strategy.

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This study is expected to contribute to the literature on gifted adolescents' social media habits. **Keywords:** Giftedness, Gifted Adolescents, Social Media Habits

INTRODUCTION

The rapid advancements in technology have integrated into our lives at the same pace, creating a fundamental change in the way we communicate. Today, communication is primarily facilitated through social media platforms, and social media has become the most widely used form of communication. Social media platforms are virtual environments where individuals with common interests come together to communicate, share ideas, and engage in discussions (Raacke & Bonds-Raacke, 2008). In these environments, users can create public or semi-public profiles, share files on their profiles, and interact with other users (Boyd & Ellison, 2007). According to We Are Social's 2025 report, 63.9% of the world's population are social media users (We Are Social, 2025). In Turkey, the proportion of social media users is 66.8% of the population, and it is anticipated that this rate will experience rapid growth in the coming years (We Are Social, 2024). Given the social media usage rates, it can be stated that social media platforms are actively used across all age groups.

While social media platforms are actively used across all age groups, adolescents are seen as pioneers in the adoption of these platforms (van Dijk, 2018). During adolescence, a period marked by numerous biological, psychological, and social changes, self-expression, identity exploration, forming friendships, and peer acceptance are of great importance to individuals (Dahl et al., 2018). Social media platforms provide adolescents with the opportunity to constantly interact with their peers and express themselves (Spies-Shapiro & Margolin, 2014). On the other hand, the concept of social acceptance, which is subjective in the real world, has become quantifiable through the number of followers, likes, and views on social media platforms (Firth et al., 2019). In this regard, social media platforms play an important role in the daily lives of adolescents (Barry & Kim, 2023; Lenhart, 2015). According to data from the Pew Research Center, 90% of adolescents (ages 13-17) use YouTube, 63% use TikTok, 61% use Instagram, and 55% use Snapchat (Faverio & Sidoti, 2024). According to the report by the Turkish Statistical Institute, 79% of adolescents are social media users (TUIK, 2024). The widespread use of social media platforms has prompted researchers to conduct studies on their scope and impact, particularly on adolescents (Longobardi et al., 2020). These studies highlight the advantages of social media platforms, such as easy access to information, the ability to communicate with people from all over the world, sharing experiences, and meeting learning needs (Bicen & Arnavut, 2015; Kara et al., 2020). On the other hand, concerns have also emerged, including social media addiction, cyberbullying, dissatisfaction with body image, fear of missing out, loneliness, depression, anxiety disorders, problematic internet use, and sleep disturbances due to prolonged screen time (Barry et al., 2019; Karabulut-Coşkun & Akar, 2022; Keles et al., 2019; Lozano-Blasco et al., 2022; Mussweiler et al., 2004; Nesi & Prinstein, 2015; Oberst et al., 2017; Oswald et al., 2020; Thorisdottir et al., 2019; Twenge et al., 2018). This contradictory situation necessitates a deeper examination of adolescents' social media habits.

It is believed that the situation may be more complex for gifted adolescents, who are defined as individuals who learn faster than their peers, stand out in creativity, leadership, and the arts, possess special academic abilities, can understand abstract ideas, prefer acting independently in areas of interest, and perform at a high level (MEB, 2023).



On one hand, they use social media platforms as a space to foster their personal development and exhibit their talents (Cross, 2004; Özcan & Biçen, 2016), while on the other hand, they may encounter disadvantageous situations on these platforms and may react unusually due to characteristics such as excessive sensitivity, high emotional reactivity, anxiety, perfectionism, and excessive self-criticism (Rimm et al., 2018). Additionally, due to their interest in learning and curiosity (Rimm et al., 2018), they may acquire incorrect information while searching for knowledge among the information pollution on social media. Therefore, examining the social media usage habits of gifted adolescents is of great importance in understanding how these individuals interact in the digital world.

When the literature is examined, it can be seen that studies have been conducted on the frequency of social media use among gifted students (Kara et al., 2020), the examination of social media communication competencies (Kara et al., 2021), identifying the problems gifted students face in career selection through social media (Kara, 2019), the differences in social media participation and peer interactions between gifted and typically developing students (Sureda-Garcia et al., 2020), investigating the motivations behind social media use among gifted individuals (Köroğlu, 2015), analyzing students' Twitter posts (Khayyat et al., 2022), exploring discussions on gifted education on the Reddit platform (Hodges et al., 2022), and the communities formed by parents for social support and information exchange for their gifted children (Jolly & Matthews, 2017). However, studies that in-depth examine the social media usage habits of gifted adolescents have not been found. Therefore, the aim of this research is to in-depth examine the social media usage habits of gifted adolescents.

METHOD

Research Design

This research is designed using the case study model, which is one of the qualitative research models. The purpose of a case study is to explore a current phenomenon or situation in its natural context in depth (Creswell, 2013; Yin, 2018). In this research, since the aim was to indepth examine the social media habits of gifted adolescents and reveal the current situation, it was conducted using a case study. In case study-based research, it is recommended to use one or more techniques such as observation, interviews, and document analysis (Creswell, 2013; Yin, 2018). In this study, interviews were conducted with participants to collect data.

Participants

The research participants were selected using criterion sampling, which is one of the purposive sampling methods, as they were expected to provide in-depth information. Criterion sampling is a type of sampling where individuals, events, or situations that meet predefined criteria are selected for study (Patton, 2015). Before selecting the participants, ethical approval was obtained, and then the criteria that participants must meet to provide in-depth information relevant to the purpose of the research were determined. Accordingly, three criteria were set for the participants: being gifted (students who have gone through the identification process conducted by the Ministry of National Education (MoNE)), being in adolescence (ages 12-18), and being a social media user (having at least one social media account). Contact was made with Science and Art Centers (SAC; centers providing afterschool enrichment programs for gifted students in Turkiye) administrators, and 18 participants who met the determined criteria and volunteered were reached. The participants' involvement in the research was obtained through written consent from their parents and verbal and written consent from the participants themselves.



Data Collection

The data for the research were collected through semi-structured interviews conducted in the individual interview rooms at the SACs attended by the participants. Before the interviews, a participant information form was used to gather data on the participants' demographic characteristics and social media usage. The participant information form includes details such as the participants' gender, age, school, how many years they have been using social media, which platforms they have accounts on, and the total number of social media accounts.

In the research, semi-structured interviews were conducted to examine the social media habits of gifted adolescents. For this purpose, an interview form was initially prepared by the researchers. The prepared interview form was presented to experts in the fields of gifted education, assessment and evaluation, and Turkish language education for their opinions. Based on the experts' evaluations and suggestions, the semi-structured interview form was finalized. Then, the day, time, and environment for the interviews with gifted adolescents who volunteered to participate and met the criteria for participation were determined. Before the interviews began, the participants were informed that the interviews would be recorded, would not be used outside of this research, and that their identities would remain confidential. The interviews were then recorded using a voice recording device.

Data Analysis

In the research, the content analysis technique was used to analyze the data obtained through semi-structured interviews. In content analysis, the processes of open coding, creating subcategories, creating categories, and developing themes (abstraction) are followed (Elo & Kyngäs, 2008). In this context, the collected data were first prepared for analysis. At this stage, the interview recordings were transferred to a computer, and the data on the computer were reviewed by the researchers. During the coding phase, each researcher assigned codes to the statements they considered reflective in the data set, and a code list was created. Similar expressions in the list were grouped to form subcategories, and the subcategories were further grouped to create themes. This process continued until consensus was reached among the researchers. After achieving agreement, the findings were reported with direct quotes from the participants, which were considered worth noting.

Credibility

In qualitative research, instead of the concepts of validity and reliability, criteria such as credibility, dependability, confirmability, and transferability are used (Yıldırım & Şimşek, 2016). In this research, to ensure credibility, participant confirmation was obtained to verify the accuracy of the interview transcripts. To ensure transferability, direct quotes and detailed information about the research process were included in the reporting of the findings. Additionally, transferability was aimed to be ensured by using criterion sampling, one of the purposive sampling methods, which allowed access to detailed information about the context being examined. To ensure dependability, an independent evaluator was involved in the research, and the evaluator was tasked with checking the transcripts of five randomly selected interviews and analyzing the data by creating a coding key in an unbiased manner. Subsequently, the coding keys created by the evaluator and the researchers were compared, and coding continued until inter-rater reliability reached 100%.



FINDINGS

The findings obtained from semi-structured interviews are categorized under four main themes: "social media habits, following trends, perception of influencers, and adverse experiences". Each theme includes categories and subcategories.

Findings Related to the Social Media Habits Theme

The present study examined participants' perspectives on social media usage within the social media habits theme, categorising these perspectives into four main areas: "role of social media, purpose of social media use, frequency of social media use, and time spent on social media." These categories were further subdivided into 13 subcategories (see Figure 1).

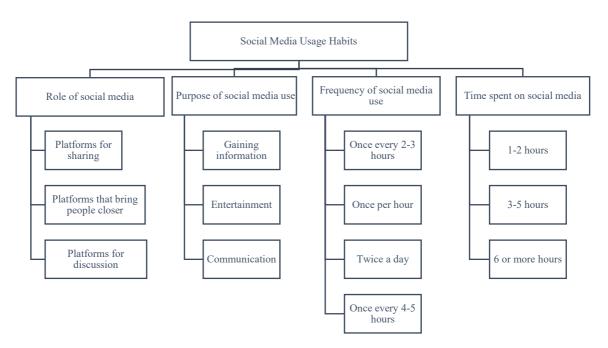


Figure 1. Categories and subcategories related to the theme of social media usage habits

In the role of social media category, participants' perceptions of the concept of social media were evaluated, with their perspectives in this category analyzed under three subcategories: " platforms for sharing, platforms that bring people closer, and platforms for discussion." In the platforms for sharing subcategory, the views of nine participants were examined, with these individuals describing social media in terms of its functions, such as sharing ideas, opinions, and photos. One participant expressed their view as follows: "*I perceive social media as a public internet platform where individuals share content visually, verbally, or in written form, and where others can sometimes view this content with restrictions or in its entirety (P7, page 1, lines 2-3)". The platforms that bring people closer subcategory encompasses the perspectives of eight participants, who described social media platforms as spaces where individuals can quickly meet and form connections. Finally, in the subcategory of platforms for discussion, the views of two participants were analyzed, with these individuals characterizing social media as an environment where people engage in discussions and express their opinions.*



Participants' perspectives on the purposes for which they use social media platforms were analyzed under the purpose of social media use category and classified into three subcategories: "gaining information, entertainment, and communication." In the gaining information subcategory, the views of 12 participants who stated that they use social media to learn about their interests and access useful content were examined. One participant's statement exemplifies both the gaining information, to help with my studies, or just for fun when I feel bored (P11, page 1, lines 10-11)". In the entertainment subcategory, the views of 10 participants who reported using social media for leisure and enjoyment were analyzed. In the communication subcategory, the perspectives of four participants who stated that they use social media to use analyzed use it friends and family were examined.

In the frequency of social media use category, participants' views on the frequency of their access to social media accounts throughout the day were examined, with their responses classified into four subcategories: "once every 2-3 hours, once per hour, twice a day, and once every 4-5 hours." Nine participants reported checking their social media accounts every 2-3 hours, with one participant expressing this habit as follows: "*I check it every 2-3 hours, at least YouTube* (P8, page 1, line 22)". Furthermore, five participants stated that they access social media once per hour, while three participants reported using it twice a day. One participant indicated that they visit social media platforms once every 4-5 hours.

In the time spent on social media category, participants' views on the number of hours they spend on social media platforms daily were examined. Their responses were classified into three subcategories: "1-2 hours, 3-5 hours, and 6 or more hours." Eleven participants reported spending 1-2 hours per day on social media platforms, while six participants indicated spending 3-5 hours daily. Additionally, one participant stated that they spend 6 or more hours on social media platforms each day.

Findings Related to the Following Trends Theme

Participants' perspectives on the accounts they follow on social media platforms were analyzed under the following trends theme, categorized into two main categories and 12 subcategories (see Figure 2).

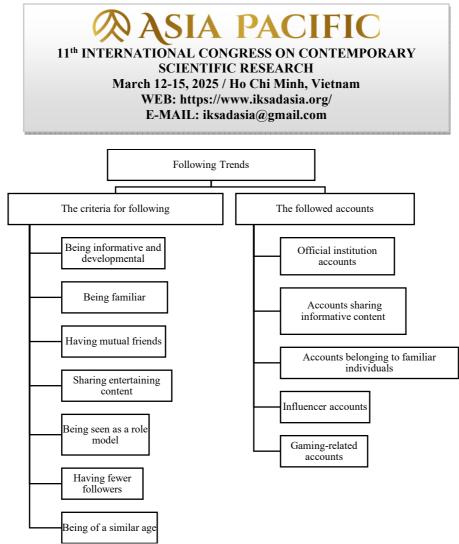


Figure 2. Categories and subcategories related to the theme of following trends

In the criteria for following category, participants' perspectives on the factors they consider when deciding to follow an account on social media platforms were analyzed. These perspectives were classified into seven subcategories: "being informative and developmental, being familiar, having mutual friends, sharing entertaining content, being seen as a role model, having fewer followers, and being of a similar age." The being informative and developmental subcategory includes the views of nine participants who stated that they follow accounts that share content related to their interests, studies, and personal development. One participant expressed this preference as follows: "I check whether the content aligns with my interests—whether I really want to see it and if I want it to appear on my feed (P18, page 4, lines 95-96)". The being familiar subcategory consists of the views of seven participants who reported following accounts belonging to people they know. Additionally, three participants mentioned that they consider whether an account has mutual friends before following it, and their views were categorized under having mutual friends. In the sharing entertaining content subcategory, two participants stated that they follow accounts that they find amusing and enjoyable. The being seen as a role model subcategory includes the perspective of one participant who follows individuals they look up to. Furthermore, one participant indicated a preference for following accounts with fewer followers, while another reported a tendency to follow individuals of a similar age.

In the followed accounts category, participants' perspectives on the types of accounts they follow on social media platforms were analyzed under five subcategories: "official institution accounts, accounts sharing informative content, accounts belonging to familiar individuals, influencer accounts, and gaming-related accounts."



The official institution accounts subcategory includes the views of 11 participants who reported following the social media accounts of their schools, SAC, and MoNE. One participant described their following preferences as follows: "*I follow my school's Instagram page, then my close friends, then maybe my relatives, and possibly my teachers as well* (P11, page 1, lines 44-45)". This statement reflects both the official institution accounts and accounts belonging to familiar individuals subcategories. In the accounts sharing informative content subcategory, eight participants indicated that they follow accounts belonging to familiar interests, hobbies, or various topics. The accounts belonging to familiar individuals subcategories of five participants who stated that they follow friends, family members, and other acquaintances on social media. Additionally, three participants reported following influencer accounts, and their views were categorized under the influencers subcategory. Lastly, two participants mentioned following accounts that produce gaming-related content, which were analyzed under the gaming-related accounts subcategory.

Findings Related to the Perception of Influencers Theme

Participants' views on influencers, who are defined as individuals with a large following on social media platforms capable of influencing their audience's purchasing decisions, were analyzed under the perception of influencers theme. This theme consists of three main categories: perceptions of the influencer concept, indicators of being an influencer, and strategies for becoming an influencer. These categories are further divided into 27 subcategories (see Figure 3).

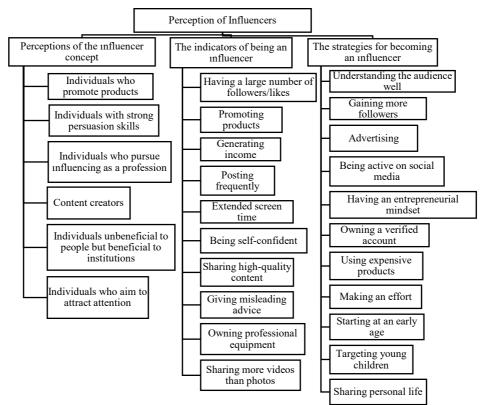


Figure 3. Categories and subcategories related to the theme of perception of influencers



Participants' perceptions of influencers were analyzed under the perceptions of the influencer concept category. The views within this category were analyzed in six subcategories: individuals who promote products, individuals with strong persuasion skills, individuals who pursue influencing as a profession, content creators, individuals unbeneficial to people but beneficial to institutions, and individuals who aim to attract attention." The individuals who promote products subcategory includes the views of seven participants who defined influencers as individuals who promote and advertise products. One participant expressed this view as follows: "Someone who records videos to promote a product (P1, page 14, line 5)". In the individuals with strong persuasion skills subcategory, five participants described influencers as individuals who can influence and manipulate others' opinions. The individuals who pursue influencing as a profession subcategory consists of four participants who viewed influencer activities as a job or profession. In the content creators subcategory, four participants perceived influencers as individuals who produce content in various fields. One participant characterized influencers as individuals who do not offer direct benefits to individuals but contribute to institutional profits and this perspective was analyzed under individuals unbeneficial to people but beneficial to institutions. Another participant expressed that influencers primarily aim to attract attention to gain likes. This perspective was analyzed under the "individuals who aim to attract attention" subcategory.

Participants' perspectives on how they identify someone as an influencer were analyzed under the indicators of being an influencer category. These perspectives were classified into ten subcategories: "having a large number of followers/likes, promoting products, generating income, posting frequently, extended screen time, being self-confident, sharing high-quality content, giving misleading advice, owning professional equipment, and sharing more videos The majority of participants stated that having a large number of than photos." followers/likes is a key indicator of being an influencer. Among the ten participants who expressed this view, one stated: "As we said, having a lot of followers is important, and I also think they need to be liked by a certain audience. Someone that everyone hates cannot be an influencer (P5, page 2, lines 39-40)". In the promoting products subcategory, seven participants described influencers as individuals who advertise and promote products. Three participants associated influencer status with posting frequently, while two participants emphasized extended screen time as an indicator. Additionally, the views of one participant each were analyzed under the following subcategories: generating income, being selfconfident, sharing high-quality content, giving misleading advice, owning professional equipment, and sharing more videos than photos.

Participants' views on the necessary steps to become an influencer were analyzed under the strategies for becoming an influencer category. These views were classified into 11 subcategories, including "understanding the audience well, gaining more followers, advertising, being active on social media, having an entrepreneurial mindset, owning a verified account, using expensive products, making an effort, starting at an early age, targeting young children, and sharing personal life." The majority of participants emphasized that understanding the needs and interests of the target audience is an effective strategy for becoming an influencer. The views of seven participants who expressed this opinion were categorized under understanding the audience well. One participant stated: "*They can create content that people might like or that aligns with their interests. By capturing people's attention and gaining more followers, they can become influencers* (P15, page 4, lines 114-118)". This statement serves as an example of both the understanding the audience well and gaining more followers.



Additionally, five participants identified increasing the number of followers as a key influencer strategy, and their views were classified under gaining more followers. In the advertising subcategory, the views of five participants who stated that promoting products is essential for becoming an influencer were analyzed. Additionally, three participants identified being active on social media as a key influencer strategy, and their views were categorized under the being active on social media subcategory. Furthermore, the views of one participant each were analyzed under the strategies for becoming an influencer subcategory: having an entrepreneurial mindset, owning a verified account, using expensive products, making an effort, starting at an early age, targeting young children, and sharing personal life.

Findings Related to The Theme of Adverse Experiences on Social Media

Under the theme of adverse experiences, participants' perspectives on the difficulties they encountered while using social media were analyzed. Participants' perspectives were analyzed under two main categories: "experiences" and "coping strategies," which were further divided into eight subcategories. Figure 4 presents the categories and subcategories related to the theme of adverse experiences.

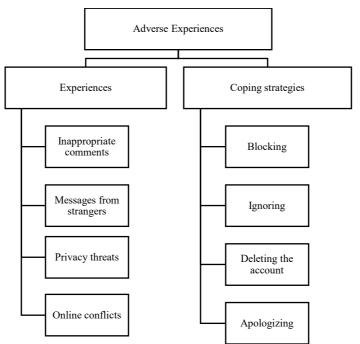


Figure 4. Categories and subcategories related to the theme of adverse experiences

In the experiences subcategory, participants' perspectives on the negative experiences they encountered on social media were examined. Based on their responses, four subcategories were identified: "inappropriate comments, messages from strangers, privacy threats, and online conflicts." The inappropriate comments subcategory includes the views of four participants who described receiving or witnessing inappropriate comments on social media platforms as a negative experience. One participant explained their experience as follows: "*I used to have a YouTube channel where I actively uploaded videos, and there were people who posted negative comments*.



Also, while browsing social media, I sometimes come across videos that I don't want to see or watch, and I also encounter unpleasant comments... (P2, page 7, lines 3-5)". In the messages from strangers subcategory, the views of three participants were analyzed. These participants reported receiving unsolicited messages and calls through social media platforms, describing this as a negative experience. In the privacy threats subcategory, three participants expressed concerns about unauthorized access to their personal information, including instances where others gained access to their unused social media accounts or had their passwords stolen. The online conflicts subcategory includes the perspectives of two participants who stated that they experienced disagreements on social media platforms, leading to conflicts arising from differences in opinions.

In the coping strategies category, participants' approaches to handling negative experiences on social media were examined. This category includes four subcategories: "blocking, ignoring, deleting the account, and apologizing." The blocking subcategory includes the views of six participants who stated that they cope with negative situations by blocking the individuals involved. One participant responded to the question "How do you cope with such situations?" by stating, "*I block the person* (P12, page 8, lines 17)". The ignoring subcategory consists of the perspectives of four participants who indicated that they remain unresponsive to negative experiences on social media. These participants explained that they choose not to react because they believe such individuals will always exist and that there is nothing, they can do to change the situation. In the deleting the account subcategory, the view of one participant who stated that they deleted their account after facing a negative experience was analyzed. Finally, in the apologizing subcategory, the view of one participant was examined. This participant stated that they apologized at the end of a social media argument in which they believed they were in the wrong.

DISCUSSION AND CONCLUSION

This study examined the social media usage habits of gifted adolescents, with 18 students aged 12 to 18 participating. Semi-structured interviews were conducted, and the collected data were analyzed using content analysis. The findings were categorized under four main themes: social media usage habits, following trends, perception of influencers, and adverse experiences.

Within the social media usage habits theme, participants shared their perspectives on the role of social media, the purpose of social media use, the frequency of use, and the time spent on social media. In the role of social media category, gifted adolescents primarily perceived social media platforms as platforms for sharing. However, despite this perception, they predominantly reported using social media to gain information. This finding suggests that their high motivation for learning and personal development, as well as their curiosity, shape their social media engagement. Similarly, Özcan and Bicen (2016) found that gifted adolescents use social networks to enhance their knowledge and engage in academic communication with others. In contrast, a study conducted with typically developing adolescents indicated that they primarily use social media to stay connected with friends and form new relationships (Raacke & Bonds-Raacke, 2008). Thus, while typically developing adolescents tend to use social media mainly for entertainment and socialization, the primary motivation of gifted adolescents appears to be academic and personal development.

The analysis of gifted adolescents' frequency of social media use revealed that they predominantly accessed and checked their social media accounts every 2-3 hours. Additionally, participants reported spending 1-2 hours daily on social media platforms.



This finding aligns with previous literature indicating that gifted individuals use social media platforms daily (Kara et al., 2020; Khayyat et al., 2022; Köroğlu, 2015; Özcan & Bicen, 2016). Similarly, studies on typically developing adolescents suggest that they also visit social media platforms on a daily basis (Özkan & Arslan, 2024; Pew Research Center, 2024; TÜİK, 2024). Thus, it can be concluded that the frequency of social media use among gifted adolescents is similar to that of their typically developing peers.

The following trends theme explored the criteria that gifted young people consider when adding or following an account on social media. The results show that they primarily focus on whether the accounts they follow have developmental or educational value. This suggests that their motivation for learning and self-improvement strongly influences their engagement with social media. In addition, this theme includes an analysis of the types of accounts that participants follow. Gifted adolescents reported following accounts of official institutions such as their schools, SAC, MoNE and university accounts. They also expressed a preference for accounts that provide content that contributes to their personal and academic growth. In support of the finding that gifted adolescents use social media primarily for the purpose of knowledge acquisition and self-improvement, it can also be deduced that they tend to seek information from sources that are both reliable and academic.

Another theme that was explored in this study is the perception of influencers, defined as individuals or accounts on social media platforms with a substantial following, who disseminate engaging content and accrue popularity as their posts are extensively reposted by others (İren, 2019). Given the societal expectations placed on gifted adolescents and their tendency toward perfectionism, the influencer-driven perception of "success" based on recognition may lead these students to compare themselves with influencers, potentially resulting in negative emotional effects. For this reason, examining gifted adolescents' perceptions of influencers on social media was considered a crucial aspect of this study. An analysis of participants' perceptions regarding influencers indicated that the predominant response characterized these individuals as promoters of products. Furthermore, the majority of participants identified a substantial number of followers and likes as pivotal indicators of influencer status. In the context of strategies for attaining influencer status, participants placed significant emphasis on the necessity of comprehending the target audience and amassing a substantial follower base. These findings suggest that gifted adolescents are capable of critically evaluating the commercial and marketing strategies prevalent on social media. A study conducted with typically developing adolescents similarly found that participants were aware of the marketing, advertising, and sales-driven intentions of influencers. In contrast, despite this awareness, the participants continued to follow influencers' recommendations, indicating that they did not always adopt a critical perspective (Özkan & Arslan, 2024). In this context, it can be posited that gifted adolescents exhibit a more critical approach toward prominent figures on social media compared to their peers.

In the context of adverse experiences on social media theme, the present study examined the troubling experiences that gifted adolescents encounter on social media, as well as their coping strategies. The majority of participants reported exposure to inappropriate messages and comments. A review of the literature indicates that inappropriate messages and comments sent via social media platforms are often categorized as cyberbullying (Akçıl, 2023; Connolly, 2018; Smith et al., 2012; Tokunaga, 2010). Therefore, it can be inferred that the challenging experiences encountered by gifted adolescents on social media also involve more complex and serious issues, such as cyberbullying.



Although social media serves as a platform for adolescents to express themselves and engage with others, it can also have negative psychological and emotional effects. This finding highlights that social media should not be viewed solely as a tool for personal development and communication but also as a factor that can impact adolescents' overall well-being.

The findings indicate that blocking was the most frequently used coping strategy among gifted adolescents when dealing with adverse experiences on social media. Previous studies have also identified blocking as one of the most common strategies adopted by victims of cyberbullying (Byrne, 2020; Livingstone et al., 2011; Machackova et al., 2013; Perren et al., 2012; Price & Dalgleish, 2010). Cyberbullying victims have reported that blocking an individual engaging in harmful behavior is a simpler and more accessible approach compared to completely deleting their accounts or avoiding online interactions altogether (Byrne, 2020). Alipan et al. (2018) explained the widespread use of blocking as a quick, effortless, and semi-anonymous strategy that allows users to protect themselves effectively. The frequent use of blocking by gifted adolescents when facing social media-related challenges can be interpreted as both a practical response to online distress and a natural defense mechanism aimed at safeguarding their emotional and psychological well-being.

Based on the findings of this study, gifted adolescents could benefit from awareness programs on cyberbullying, emotional support initiatives, and psycho-educational interventions to help them cope with the challenging experiences they encounter on social media. Additionally, to promote more effective and constructive social media use, informational seminars could emphasize the educational potential of social media platforms. Furthermore, digital literacy and social media safety training could be implemented to help adolescents filter misinformation and access reliable sources amid the vast amount of online content.

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SIR ALTI MAVİ-BEYAZ VE TEK RENKLİ VİETNAM (ANNAMESE) SERAMİKLERİ (14. - 17. YÜZYILLAR)

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ÖZET

Seramikler, binlerce yıldır Güneydoğu Asya'da önemli bir sanatsal ifade aracı olmuştur. Güneydoğu Asya'daki seramik üretiminin ana merkezlerinden biri olan Vietnam, kendi adıyla ve eskiden Annamese ile özdeşleşen, Asya genelinde oldukça iyi bilinen seramikleri ile ön plana cıkmaktadır. Vietnam seramikleri yenilikci Batı tekniklerini kusursuz bir sekilde kendi bezeme repertuvarına entegre ederek sanatsal formları ve üslupları daha da zenginleştirmiş, estetik değere sahip eserler ortaya çıkarmıştır. Kendilerine özgü stilleri ve biçimleri olan bu eserler çeşitli formlara sahip, çoğunlukla sıraltı mavi-beyaz boyama tekniğinde ve tek renk sırlarla bezenen dekoratif özelliklere sahiptir. Günlük yaşamda işlevleri olan, depolama, sunum ve servis kapları olarak kullanılan bu seramiklerin özellikle 15. ve 16. yüzyıllarda Asya genelinde ticareti yapılmıştır. Sıraltı mavi-beyaz dekorlu ve monokrom (tek renk sırlı) Vietnam seramiklerinde kullanılan motiflerin çoğu kabul edildiği ve bilindiği üzere Çin kültüründen alınmıştır. Ancak, Vietnam seramiklerinde bezeme repertuvarı grafiksel ve üslupsal olarak belirgin bir fark yaratmaktadır. Özellikle Vietnam mavi-beyaz seramiklerinin dekorasyonu alışılmışın dışında bir motif zenginliğiyle karakterize edilebilmektedir. Bu nedenle Çin desenlerinden esinlense bile yerel kültür ve dinsel etkilere açık biçimde olusturulan, kendine has dekoratif vönlere sahip olduğu görülebilmektedir. Vietnam ya da önceden daha yaygın olarak bilinen Annam seramiklerinde tespit edilen bu özellikler henüz son yıllarda araştırılmaya başlanmıştır. Elde edilen bulgular, kültürel değişim çerçevesine dahil edilmeden dar bir şekilde stilistik yönlere veya teknolojik yeniliklere odaklanmıştır. Bu seramikleri üreten fırınların tespiti, fırınlama ve üretim teknolojileri, sırlama ve pişirme teknikleri hakkında ise çok daha az araştırma yapılmıştır. Bu bağlamda-özellikle Çin ve Vietnam seramikleri arasındaki karşılıklı ilişkileri tam olarak anlamak için-daha kapsamlı arkeolojik ve teknolojik analize ihtiyaç vardır. Bu çalışmada tarihi kaynaklara, arkeolojik verilere ve çeşitli görsellere dayanarak ele alınan Vietnam seramikleri, 14. yüzyıl dahil 18. yüzyıla kadar üretilen sıraltı mavi-beyaz ve monokrom örnekler üzerinden açıklanmaktadır. Vietnam'daki seramik geleneklerinin oluşumu, teknoloji ve üslup transferi ile yerel özellikler, müze ve koleksiyonlardaki eserler ışığında yeni arkeolojik verilerle birlikte değerlendirilerek tarihsel ve analitik bir şekilde incelenmiştir.

Anahtar Kelimeler: Vietnam, Annam, Seramik, Mavi-Beyaz, Monokrom, Üretim, Üslup.

UNDERGLAZED BLUE-WHITE AND MONOCHROME VIETNAMESE (ANNAMESE) CERAMICS (14TH TO 17TH CENTURIES)

ABSTRACT

Ceramics have been an important medium of artistic expression in Southeast Asia for thousands of years. Vietnam, one of the main centers of ceramic production in Southeast Asia, stands out with its ceramics, which are well-known throughout Asia, and which were previously identified with Annamese.



Vietnamese ceramics have seamlessly integrated innovative Western techniques into their decorative repertoire, further enriching artistic forms and styles, and producing works of aesthetic value. These works, which have their own unique styles and forms, have various forms, mostly underglazed blue-white painting technique and decorative features with singlecolor glazes. These ceramics, which have functions in daily life, were used as storage, presentation and serving vessels, and were traded throughout Asia, especially in the 15th and 16th centuries. Most of the motifs used in underglazed blue-white decorated and monochrome (single-color glazed) Vietnamese ceramics are accepted and known to have been taken from Chinese culture. However, the decorative repertoire in Vietnamese ceramics creates a distinct difference in terms of graphics and style. In particular, the decoration of Vietnamese blue and white ceramics can be characterized by an unusual richness of motifs. Therefore, it can be clearly seen that even though it is inspired by Chinese patterns, it has its own decorative aspects that are open to local cultural and religious influences. These features, which are detected in Vietnamese or previously more widely known Annamese ceramics, have only recently begun to be investigated. The findings obtained have focused narrowly on stylistic aspects or technological innovations without being included in the framework of cultural change. Much less research has been done or published on the identification of the kilns that produced these ceramics, their firing and production technologies, and glazing and firing techniques. In this context, more comprehensive archaeological and technological analysis is needed - especially to fully understand the mutual relations between Chinese and Vietnamese ceramics. In this study, Vietnamese ceramics, which are examined based on historical sources, archaeological data and various visuals, are explained through underglazed bluewhite and monochrome examples produced from the 14th century to the 18th century. The formation of ceramic traditions in Vietnamese, the transfer of technology and style, and local characteristics are examined historically and analytically, together with new archaeological data in the light of works in museums and collections.

Keywords: Vietnamese, Annamese, Ceramic, Blue-White, Monochrome, Production, Style.



NUBAR TEKYAY'IN GAZİNO VE RADYO İCRA TAVIRLARININ İNCELENMESİ VE MUKAYESESİ

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ÖZET

Nubar Tekyay (1905-1955), Klasik Türk Müziği keman icrasında önemli bir ekol olmuş ve kendine özgü icrasıyla ve teknik becerisiyle, Klasik Türk Müziği keman icrasında önemli bir rol oynamıştır. Kendisinden sonraki hem keman icracıları hem de diğer saz icracılarının tavırları üzerinde etkisi büyük olan Tekyay, bıraktığı kayıtlarla klasik üslubun takipçilerini etkilemiş, aynı zamanda da kendi döneminde eğlence endüstrisinin önemli bir parçası olan, bugün "piyasa müziği" olarak da adlandırılan gazino icralarının içinde de yer almıştır. Bu calışmada, Tekyay'ın 1951 yılında Tepebaşı gazinosunda icra ettiği Kemani Tatyos'a ait Karcığar Peşrev ile radyo kaydında çaldığı Kemençeci Vasilaki'ye ait Kürdilihicazkar Peşrev arasındaki icra farkları ve benzerlikler incelenmiştir. Çalışma, Tekyay'ın gazino sahnesindeki ve radyo kayıtlarındaki icra tavrını karşılaştırarak, her iki mecra içerisinde icrasının dinamiklerini olusturan süsleme tekniklerinin kullanım sekillerinin benzerlik ve farklarını ortaya koymaktadır. Bu karşılaştırma, dönemin eğlence endüstrisi müziği ve "piyasa üslubu" hakkında da önemli bilgiler sunmaktadır. Araştırmada tarama modeli kullanılmıştır, veriler doküman inceleme ve kaynak tarama yöntemleriyle toplanmıştır. İcralar notaya alındıktan sonra, bu notalar üzerinden yapılan kategorisel icerik analizi sonucunda mekanlar ve icra ortamları farklı olsa da Tekyay'ın her iki icrasında da süsleme tekniklerinin benzer kullanımlara sahip olduğu saptanmıştır.

Anahtar Kelimeler: Nubar Tekyay, Klasik Türk Müziği keman, tavır, icra tahlili.

ANALYSIS AND COMPARISON OF NUBAR TEKYAY'S CASINO AND RADIO PERFORMANCE STYLES

ABSTRACT

Nubar Tekyay (1905-1955) became an important school in Classical Turkish Music violin performance and played an important role in Classical Turkish Music violin performance with his unique playing and technical skills. Tekyay, who had a great influence on both violinists and other instrumentalists after him, influenced the followers of the classical style with the recordings he left behind, and at the same time, he was also involved in the performances of the casino, which was an important part of the entertainment industry in his period, and which is also called "piyasa müziği" today. In this study, the differences and similarities between the Karcığar Peşrev of Violinist Tatyos, which Tekyay performed at the Tepebaşı casino in 1951, and the Kürdilihicazkar Peşrev of Violinist Vasilaki, which he played on the radio recording, are analyzed. This comparison also provides important information about the music of the entertainment industry and the "market style" of the period. The research is based on the survey model and the data collected through document analysis and literature review methods. After the performances were notated, a categorical content analysis of these notes revealed that both of Tekyay's performances have similar uses of ornamentation techniques. **Keywords:** Nubar Tekyay, Classical Turkish Music violin, style, analysis of performance.

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Giriş

Klasik Türk Müziği icra üslubu ve onun kuralları birçok akademik çalışmanın konusu olmuş, birçok yazar, düşünür ve sanat insanı bu konuyla ilgili görüş bildirmişlerdir. Klasik icra üslubunun nasıl olması gerektiği sorusunu ortaya çıkaran asıl sebep ise bu üslubun dışındaki icraların ortaya çıkması ve yaygınlaşmasıdır. Daha da ötesi genelde piyasa üslubu diye isimlendirilen bu icraların klasik icra üslubunun zamanla içine sızarak bu icra üslubunun kaidelerini muğlaklaştırması da klasik üslubun ne olduğu sorusunu bir araştırma problemi haline getirmiştir.

Klasik icra üslubunun ne olduğunu kavrayabilmek adına onun içerisinde yetiştiği ortamı, zamanı ve kültürü anlamak gerektiği gibi piyasa icra üslubunun içerisinde geliştiği ortamı, zamanı ve mekanı da anlamak gerekmektedir. Esasında kendi içlerinde de durmadan evrim geçiren bu iki kavramın çatışma noktalarının ne olduğunun anlaşılması, sürecin çözümlenmesinde yardımcı olacaktır. Eserleri, kökeni ve Ayas'ın da belirttiği gibi tarihsel süreç içerisinde mekanları dahası saray, meşkhaneler, konaklar, kahvehanelerdeki icracıları aynı olan (Ayas, 2020: 39), bu iki üslubun farklılaşmasını anlamlandırabilmek için tarihsel olarak gelişim süreçlerinin de farklılaşmasını anlamak gerekmektedir. Çalışmada ele alınan konunun özünde müziksel farklılıklar yatsa da dönemin sosyal süreçlerinin de anlaşılması önem arz etmektedir.

Bu çerçevede dönemin sosyal süreçlerinin getirisi olarak ortaya çıkan, piyasa üslubunun geliştiği mekanlar olan gazinolar da bu süreçte büyük önem arz etmektedir. Gazinoların ve içerisinde yapılan müziğin ne olduğunun anlaşılması da bu icra üsluplarının farklarının anlaşılmasında önem arz etmektedir. Üsluplar arasındaki farkın hep aynı mı olduğu yoksa zaman içerisinde mi geliştiği de bu süreçler anlaşıldıkça ortaya çıkacaktır. Daha özelde ise iki ortamda da icraları bulunan icracıların, icraları kıyaslanarak bu icracıların tavırlarının mekanlar ve üsluplar arası nasıl değiştiği anlaşılabilir. Bu amaçla hem klasik üsluplu icralarda hem de piyasa icrası üslubundaki icralarda sıklıkla kendine yer bulan kemanın Klasik Türk Müziği'ndeki en önemli icracılarından olan Nubar Tekyay'ın gazinoda ve radyodaki icralarının kıyaslanması ve farklarının ortaya koyulması da keman icracılığı üzerinden konuya ışık tutup, keman ve Nubar Tekyay özelinde de icra farklılıklarının anlaşılmasını sağlayacaktır. Bahsi geçen durumların anlaşılabilmesi için öncelikle klasik icra üslubunun ve bunun dışında kalarak "piyasa icra üslubu" olarak ifade edilen üslubun içerisinde geliştiği süreçlerin ortaya koyulması gerekmektedir.

Klasik Üslubun ve Piyasa Üslubunun Gelişim Süreçleri

Erken Cumhuriyet dönemiyle birlikte yeni kurulan devletin, Osmanlı ve onun kalıntılarından kaçış sürecinden Türk Müziği de nasibini almıştır. Modernleşme çalışmalarına tüm sosyal ve kültürel öğeler dahil olurken yeni cumhuriyetin yeni müziği de yaratılmak istenmiştir. Bu süreçte ise bilindiği üzere bazı eksiklikler peyda olmuştur. Erken Cumhuriyet dönemi politikaları çerçevesinde Klasik Türk Müziği'ne karşı alınan tavır, toplumun kendi müziğini ötelemesine ve yaratılmak istenen yeni müziğin temellerinin eksik kalmasına sebep olmuştur denilebilir. Frith'in de belirttiği üzere esasında bir müzik "kötü" olarak addedilirken onu kötü yapan faktör müziğin dinamikleri değil, istenmeyen bir sistemin ürünü olmasıdır (Frith, 2004: 22). Osmanlı'dan ve onun sosyokültürel yapıtaşlarından kaçış süreci Türk Müziği'nden bir kopuş ve onun devletçilik anlayışından mahrum kalmasına sebep olmuştur.

Ancak bu süreç içerisinde devletin yeni bir müzik algısı yaratma çabaları tabii olarak karşılıksız kalmıştır.



Toplumun bir anda örf ve ananelerini bırakması mümkün olmadığı gibi alışkın olduğu ve gündelik yaşamının bir parçası olan müzikten de vazgeçmesi de mümkün değildir. Hali hazırda Osmanlı'da müzik pratiklerinin şehirli bir ortak kültür etrafında birleşmesi de yadsınamaz bir gerçeklik olarak ortaya çıkmaktadır. Bu süreç içerisinde Klasik Türk Müziği Osmanlı'dan gelen pratikleriyle birlikte günlük yaşam içerisinde varlığını sürdürmüş, sürecin devamında ise özellikle radyo çatısı altında varlığını sürdürürken onun temellerinden hareketle kendi var oluşunu yaratmaya başlayan bir diğer üsluba da öncülük etmiştir. Bu üslup da çeşitli adlandırmalarıyla var olsa da genellikle "piyasa tavrı" olarak ifade edilen üsluptur.

Özellikle Klasik Türk Müziği'nin devletin yayın organlarından kovulmaya başlanmasıyla birlikte konaklar, meşkhaneler ve özellikle de halkın ulaşımının günümüze oranla çok daha kolay olduğu gazinolar müziğin icra ortamları olmuştur. Ancak altı çizilecek bir diğer önemli nokta da gazinolarda icra yapan neredeyse tüm icracıların Klasik Türk Müziği'nin kalesi konumundaki radyolarda da icracı olarak bulunmasıdır. Aynı icracılar bugün klasik üslup diye adlandırılan icrayı radyoda yaparken gazino sahnesinde de icralarını sürdürmekteydiler. 1960'lara kadar Safiye Ayla, Müzeyyen Senar, Perihan Altındağ, Sabite Tur Gülerman gibi isimlerin radyodakilerden çok da farklı olmayan icraları gazino sahnelerinde yaptıkları bilinmektedir (Aksoy, 2009: 82).

Küreselleşmenin etkileriyle birlikte somut veya soyut her varlığın bir pazar alanı olmaya başlaması müzik piyasasını da etkilemiş bu durum da özellikle gazinolar üzerinden başlayan bir üslup inşasının temellerini atmıştır denilebilir. Gazinolarda oluşan bu yeni üslupla klasik üslubun arasındaki farkların ne olduğu sorusu birçok akademik çalışmanın konusu olmuştur. Birçok icracı ve akademisyen bu iki üslubun temel farklarının ne olduğu sorusu üzerine çalışmalar yapmışlardır¹.

Gazinolarda ve radyoda icralar yapan önemli isimlerden birisi de konunun da odağında olan Nubar Tekyay'dır. Nubar Tekyay 1905 yılında İstanbul'da doğmuştur. Batı tekniği keman eğitimine başlayan Tekyay, akabinde müzisyen babası ile Klasik Türk Müziği meşk etmiştir (Öztuna, 1976: 313).

Kendine has icra tavrıyla adından bahsettiren Tekyay, birçok icracı ile radyoda icralar da bulunmaya başlamıştır (Özalp, 2000: 253). Tekyay, bu icralarının yanı sıra 1928-1937 yılları arasında "Columbia", "Sahibinin Sesi" ve "Pathe" kayıt şirketleriyle, önemli icracılarla birlikte kayıtlar doldurmuştur (Gürel, 2016: 5). Nubar Tekyay, 12 Şubat 1955'te vefat etmiştir (Öztuna, 2006: 386). Dönemin radyo, plak icralarında yer alan Tekyay, gazino icralarında da yer almıştır.

Çalışmada elde bulunan kayıtlar değerlendirilerek Nubar Tekyay'ın 1955 yılında Sabite Tur Gülerman'a eşlik ettiği Tepebaşı Gazinosu icrasındaki Kemani Tatyos'a ait Karcığar Peşrev icrası ile radyoda icra ettiği Vasilaki'ye ait Kürdilihicazkar peşrevi icraları tahlil edilerek hem iki icranın üslupları kıyaslanmış hem de dönemin gazino icrası üslubunun ne olduğu sorusuna cevap bulunmaya çalışılmıştır.

¹ Ayrıntılı bilgi için bkz. Yahya Kaçar, G. (2020). *Türk Mûsıkisinde Eser ve İcrâ Tahlîli Yöntemleri*. Ankara: Gece Kitaplığı., Aksoy, B. (2009). *Cüneyt Orhon Anlatıyor: Radyo Günlerim*. İstanbul: Pan Yayıncılık., Ersoy Çak, Ş. & Beşiroğlu, Ş. Ş. (2016). *Bir Muhabbet Kuşu: Postmodern Gölgeler Işığında Zeki Müren*. İstanbul: Tarih Vakfı Yurt Yayınları.



BULGULAR

Nubar Tekyay'ın Karcığar Peşrev Gazino İcrası (Kemani Tatyos) ve Kürdilihicazkar Peşrev Radyo İcralarının (Kemençevi Vasilaki) Tahlili Pu hölümdə Nubar Takusu'ın ierələri tahlil edilmiştir

Bu bölümde Nubar Tekyay'ın icraları tahlil edilmiştir.

Süsleme Teknikleri <u>Çarpma Süsleme Tekniği</u>

Nubar Tekyay gazinoda icra ettiği Karcığar Peşrev icrasında tüm ölçülerde çarpma süsleme tekniğine başvurmuştur. Radyoda icra ettiği Kürdilihicazkar Peşrev'in 67 ölçüsünde çarpma süsleme tekniğine başvurmuştur.



Karcığar Peşrev icrasında çarpma süsleme tekniği kullanımı örneği



Kürdilihicazkar Peşrev icrasında çarpma süsleme tekniği kullanımı örneği

Nubar Tekyay'ın iki icrada da sıklıkla çarpma süsleme tekniğine başvurduğu, bu kullanımlarını çarpma süsleme tekniğini eserin tüm bölümlerinde hem perdeler arasındaki geçişlerde bütüncül bir duyum sağlamak hem de keman tavrının bir parçası olarak kullandığı görülmektedir. Her iki icrada da çarpma süsleme tekniklerinde vurgulardan kaçındığı görülmektedir.

<u>Mordan Süsleme Tekniği</u>

Nubar Tekyay gazinoda icra ettiği Karcığar Peşrev icrasında 8 ölçüde, radyoda icra ettiği Kürdilihicazkar Peşrev'in 12 ölçüsünde mordan süsleme tekniğine başvurmuştur.



Kürdilihicazkar Peşrev icrasında mordan süsleme tekniği kullanımı örneği

Nubar Tekyay'ın iki icrada da mordan süsleme tekniği kullanımlarına başvurduğu görülmektedir. Nubar Tekyay'ın eserin farklı bölümlerinde diğer süsleme tekniklerinin önünde ve arkasında icrayı çeşitlendirmek için mordan süsleme tekniğini kullandığı görülmektedir. Her iki eserde de mordan süsleme tekniğini eserin aslını bozmadan, kendi icra tavrının dışındaki vurgulardan kaçınarak icra ettiği görülmektedir.



Vurkaç Çarpma Süsleme Tekniği

Nubar Tekyay gazinoda icra ettiği Karcığar Peşrev icrasında 9, radyoda icra ettiği Kürdilihicazkar Peşrev'in 26 ölçüsünde vurkaç çarpma süsleme tekniğine başvurmuştur.



Karcığar Peşrev icrasında vurkaç çarpma süsleme tekniği kullanımı örneği



Kürdilihicazkar Peşrev icrasında vurkaç çarpma süsleme tekniği kullanımı örneği

Tekyay'ın hem eserin ezgisel dolaşımına bağlı olarak hem de Karcığar peşrevi sadece bir hane bir teslim icra ettiği göz önüne alındığında, Kürdilihicazkar Peşrevde daha fazla vurkaç çarpma süsleme tekniğine başvurduğu görülmektedir. Tekyay'ın vurkaç çarpma süsleme tekniklerinde de aşırı vurgulardan kaçındığı görülmektedir.

Glissando Süsleme Tekniği

Nubar Tekyay gazinoda icra ettiği Karcığar peşrev icrasında 3, radyoda icra ettiği Kürdilihicazkar Peşrev icrasında 9 ölçüde glissando süsleme tekniğine başvurmuştur.



Karcığar Peşrev icrasında glissando süsleme tekniği kullanımı örneği



Kürdilihicazkar Peşrev icrasında glissando süsleme tekniği kullanımı örneği

Nubar Tekyay iki eserin icrasında da glissando süsleme tekniği kullanımlarını eserin aslını bozmadan, bütüncül duyumuna etki etmeden, art arda olmasından kaçınarak, vurgusuz bir şekilde icra ettiği görülmektedir.

Tril Süsleme Tekniği

Nubar Tekyay gazinoda icra ettiği Karcığar peşrev icrasında tril süsleme tekniğine başvurmazken, radyoda icra ettiği Kürdilihicazkar Peşrev icrasında 9 ölçüde tril süsleme tekniğine başvurmuştur. Herhangi bir kıyaslanacak unsur bulunmamaktadır.



Kürdilihicazkar Peşrev icrasında tril süsleme tekniği kullanımı örneği

Grupetto Süsleme Tekniği

Nubar Tekyay gazinoda icra ettiği Karcığar peşrev icrasında grupetto süsleme tekniğine başvurmazken, radyoda icra ettiği Kürdilihicazkar Peşrev icrasında 1 ölçüde grupetto süsleme tekniğine başvurmuştur. Herhangi bir kıyaslanacak unsur bulunmamaktadır.



Kürdilihicazkar Peşrev icrasında grupetto süsleme tekniği kullanımı örneği

Vibrato Süsleme Tekniği

Nubar Tekyay'ın hem gazinoda icra ettiği Karcığar Peşrev icrasında, hem de radyoda icra ettiği Kürdilihicazkar Peşrev icrasında vibrato süsleme tekniklerine sıklıkla başvurduğu görülmektedir.

SONUÇ

İncelenen iki icra da 20. Yüzyılın ortasına aittir. Piyasa icra üslubu ve klasik icra üslubu arasındaki farkları oluşturan temel unsurlar çoğunlukla süsleme tekniklerinin, usullerin, nüansların ve vurguların kullanım biçimleriyle oluşmaktadır. Bu çerçevede çalışmada Nubar Tekyay'ın radyoda icra ettiği Kemençevi Vasilaki'ye ait Kürdilihickar Peşrevi ve Tepebaşı gazinosunda icra ettiği Karcığar Peşrev'inde kullanmış olduğu süsleme teknikleri incelenmiştir. Bu incelemelerin sonucunda iki icrasında da çarpma süsleme tekniğini eserin tüm bölümlerinde hem perdeler arasındaki geçişlerde bütüncül bir duyum sağlamak hem de tavrın bir parçası olarak kullandığı anlaşılmaktadır ve iki kullanım arasında bir fark görülmemektedir. İki icrada da mordan süsleme tekniğini eserin farklı bölümlerinde diğer süsleme tekniklerinin önünde ve arkasında icrayı çesitlendirmek için kullandığı saptanmıştır ve iki kullanım arasında bir fark olmadığı söylenebilir. Tekyay'ın vurkaç çarpma süsleme tekniği kullanımında iki icrada da vurgulardan kaçındığı görülmektedir ve kullanımlar arasında fark olmadığı net bir şekilde ifade edilebilir. Nubar Tekyay iki eserin icrasında da glissando süsleme tekniği kullanımlarını eserin aslını bozmadan, bütüncül duyumuna etki etmeden, art arda olmasından kaçınarak, vurgusuz bir şekilde icra ettiği görülmektedir. Tril ve grupettonun karsılastırılabilmesi için yeterli veriye ulaşılamazken Tekyay'ın hem gazinoda icra ettiği Karcığar Peşrev icrasında, hem de radyoda icra ettiği Kürdilihicazkar Peşrev icrasında vibrato süsleme tekniklerine sıklıkla başvurduğu görülmektedir. İcralar incelendiğinde net bir şekilde anlaşılmaktadır ki, dönemin piyasa icra tavrı ile radyo icra tavrı arasındaki farklar henüz oluşmamıştır. Tekyay iki icrasını da bugün ekol olarak kabul edilen tavrıyla sergilemiştir. Bu bilgiler aynı zamanda dönemin piyasa üslubu icrasının klasik üsluptan ayrılmadığını, eğlence sektöründe yapılan icraların da klasik üslupla paralellik gösterdiğine işaret etmektedir.



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MEDYA MANİPÜLASYONU VE EKONOMİNİN DEĞİŞEN ROLÜ: SEÇMEN DAVRANIŞINI ŞEKİLLENDİREN DİNAMİKLER

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ÖZET

Bu çalışma, oy verme davranışında ekonomi ve medyanın rolünü, özellikle kutuplaşma ve medya manipülasyonunun etkilerini ele alır. Acemoğlu, Gazeteci Ruşen Çakır'a (2023) verdiği röportajda ekonominin seçimlerde eskisi kadar etkili olmadığını ifade eder, çünkü kutuplaşma artmış, medya bağımsızlığını kaybetmiştir. Bu durumun da seçmenlerin doğru bilgilere ulaşmasını engellediğini söyler. Medya, yanlış bilgilerin yayılmasına ve halkın tepkilerinin manipüle edilmesine yol açar. Acemoğlu, Türkiye özelinde son dönemdeki ekonomik krizlerin, hükümetin yanlış politikaları sonucu ortaya çıktığını, muhalefet partisinin daha iyi ekonomi politik çözüm önerileri sunmasına rağmen medyanın muhalefetin bu konuda başarısız olacağı yönündeki haberleri sebebiyle ve kendilerine sağlanan hizmetlerden dolayı minnettarlık hissi taşıdığı için seçmenin oy verme davranışını varolan hükümet lehine gelistirdiğini belirtir. Secmenlerin oy verme davranısı toplumsal faktörlerden etkilenir. Bu süreç, medya, dini kurumlar ve sendikalar gibi farklı etkenler tarafından şekillendirilir. Günümüzde ise, basın yayın, sosyal medya, dijital veri madenciliği yapan küresel teknolojik kurumlar insanların politik tercihlerini etkilemek için güçlü araçlar haline gelmiştir, bu durum "The Great Hack" (2019) adlı belgesel medyada açık bir şekilde anlatılmıştır. Daha yakın tarihli çalışmalar, sağ ve sol partilerin ekonomik meselelerde yaklaşımlarının benzerliğini ele alır "Sorry We Missed You" (2019) filmi bu konuyu eleştirir niteliktedir. Sosyal ve kültürel alışkanlıklar da siyasi tercihleri yönlendirir. Seçimlerin sonucu, sadece ekonomik faktörlerden değil, aynı zamanda toplumsal algılardan etkilenir. Son yıllarda seçimle iktidara gelmenin zorlaştığı ve siyasi hareketlerin çözüm üretmekte zorlandığı görülebilir. Bu, popülist ve aşırı sağ hareketlerin güç kazanmasıyla ilgilidir. Medya araçlarının iktidarın güçlendirilmesindeki rolü ve manipülasvonun toplum üzerindeki etkileri de tartısılmaktadır. Bu bağlamda, seçimlerin ekonomi ve medya ilişkisi içinde nasıl dönüştüğü, küresel düzeyde benzer dinamiklerle incelenmektedir. Medyanın, toplumun doğru bilgiyi almasını engellediği ve iktidarın bu gücü kullanarak halkın algısını şekillendirdiği tartışılmaktadır, bu durum "The Social Dilemma" (2020) adlı belgesel çalışmasında da görülebilir.

Anahtar Kelimeler: Ekonomi, medya, seçmen davranışı, The Great Hack

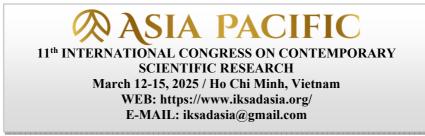
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MEDIA MANIPULATION AND THE CHANGING ROLE OF THE ECONOMY: DYNAMICS SHAPING VOTER BEHAVIOR

ABSTRACT

This study examines the role of the economy and media in voting behavior, particularly focusing on the effects of polarization and media manipulation. In an interview with journalist Ruşen Çakır (2023), Acemoğlu states that the economy no longer plays as significant a role in elections as it once did, due to increased polarization and the loss of media independence. He argues that this situation prevents voters from accessing accurate information. Media contributes to the spread of misinformation and the manipulation of public reactions. Acemoğlu highlights that recent economic crises in Turkey have emerged as a result of the government's erroneous policies, and although the opposition party has presented better economic solutions, the media's portrayal of the opposition as ineffective, combined with the electorate's gratitude for the services provided by the government, has led voters to favor the ruling party at the ballot box. Voter behavior is shaped by societal factors. This process is influenced by various elements, including the media, religious institutions, and trade unions. Today, however, mainstream media, social media, and global technological corporations engaged in digital data mining have become powerful tools for influencing political preferences. This phenomenon is vividly portrayed in the 2019 documentary "The Great Hack" More recent studies address the similarity in the economic approaches of both rightwing and left-wing parties. The 2019 film Sorry We Missed You critically examines this issue. Social and cultural habits also guide political preferences. The outcome of elections is affected not only by economic factors but also by societal perceptions. In recent years, it has become increasingly difficult to attain power through elections, and political movements are struggling to find solutions. This is related to the rise of populist and far-right movements. The role of media tools in strengthening political power and the impact of manipulation on society are also discussed. In this context, the transformation of elections within the relationship between the economy and media is explored, with similar dynamics observed on a global scale. Media is seen as obstructing the public's access to accurate information, and those in power utilize this to shape public perception. This issue is also highlighted in the 2020 documentary The Social Dilemma.

Keywords: Economy, media, voter behavior, The Great Hack



TRAVMADAKİ ÇOCUĞUN HEMŞİRELİK BAKIMI

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ÖZET

Ani olarak meydana gelen, yaşamı tehdit eden ya da yaşam konforunu bozan ve hasta ya da hasta yakınları tarafından hızlı bir çözüm üretilemeyen olağan dışı durumlar acil olarak nitelendirilirler. Acil servisler, acil müdahale gerektiren hem çocuk hem de yetişkin hastaların kabul edildiği zorunlu servisler olup travma hastalarının da hastaneye giriş kapısı olması yönüyle oldukça önemlidir. Bu birimler günün 24 saati sürekli sağlık hizmeti sunan ünitelerdir. Acil servisler kaotik, kalabalık, karışık ve yoğun stresin olduğu bölümlerdir. Çocuk hastalar, yetişkin hastaların küçük birer kopyası değillerdir, farklı bir anatomiye ve fizyolojiye sahip oldukları göz önünde bulundurularak buna göre değerlendirilmeleri gerekmektedir. Çocuk acil tıbbı, erişkin acil tıbbından farklı doğası gereği iyi bir iletişim, empati, geniş bir bilgi donanımı ve farklı beceriler gerektirir. Acil servislerde, tanı ve tedavi için tıbbi müdahaleler daha sık ve hızlı yapılmakta, bu kapsamda ağrılı girişimlere örnek teşkil edecek ıv enjeksiyonlar, ım enjeksiyonlar, sütürasyon, yabancı cisim çıkarma işlemleri, ekstremite redüksiyonları, yanığa müdahale gibi birçok girişim yer almaktadır. Bu işlemlere maruz kalan çocukların büyük çoğunluğu da ağrı, kaygı ve korku yaşarlar. Bu duygular birbirleriyle ilişkilidir ve birbirini tetikler. İnvaziv tıbbi işlemlerin çocuklara başarılı bir şekilde uygulanmasına yardımcı olmak adına aile bireyleri ve sağlık profesyonelleri genellikle çocuğu rahatlatmak için ek süre harcamaktadırlar. Bazı durumlarda çocuğun kısıtlanması ve tedavinin zorla uygulanması gerekebilir. Çocukları kısıtlamak ve onlara invaziv tıbbi işlemi zorla vapmak, huzursuzluklarının artmasına ve kaçma girişimlerine neden olabildiği gibi çocuklar üzerinde psikolojik olarak olumsuz etki de yaratabilmektedir. Travmatik olaylara maruz kalan çocukların önemli bir kısmında uyumsuz duygusal ve davranışsal tepkiler geliştiği, gelişim ve uyum mekanizmalarının bozulduğu bilinmektedir. Bu nedenle invaziv girişimler sırasında çocukların işleme uyumunu sağlayacak hemşirelik uygulamalarının kullanılması çocukların işleme uyumunu kolaylaştıracaktır. Dolayısıyla travmadaki çocuğun hemşirelik bakımı ve girişimlerinin doğru ve zamanında yapılması çocuğun gerek fiziksel gerek psikolojik olarak tam bir iyilik halinde olması için travma hemşireliği önem arz etmektedir.

Anahtar Kelimeler: Acil Servis, Travma, Acil Hemşireliği



NURSING CARE OF THE CHILD IN TRAUMA

ABSTRACT

Extraordinary situations that occur suddenly, threaten life or disrupt the comfort of life, and for which a quick solution cannot be produced by the patient or their relatives are described as emergencies. Emergency services are compulsory services where both child and adult patients requiring urgent intervention are admitted, and they are also very important as they are the gateway to the hospital for trauma patients. These units are units that provide continuous health service 24 hours a day. Emergency departments are chaotic, crowded, confused and high-stress departments. Pediatric patients are not small copies of adult patients; they must be evaluated accordingly, taking into account that they have a different anatomy and physiology. Pediatric emergency medicine, due to its different nature from adult emergency medicine, requires good communication, empathy, extensive knowledge and different skills. In emergency departments, medical interventions for diagnosis and treatment are performed more frequently and quickly, and in this context, many interventions such as IV injections, IM injections, suturation, foreign body removal procedures, limb reductions, and burn intervention are included, which are examples of painful interventions. The majority of children exposed to these procedures experience pain, anxiety and fear. These emotions are interrelated and trigger each other. To help children successfully perform invasive medical procedures, family members and healthcare professionals often spend additional time reassuring the child. In some cases, it may be necessary to restrict the child and force the treatment. Restricting children and forcing them to undergo invasive medical procedures can lead to increased anxiety and escape attempts, as well as a negative psychological impact on children. It is known that a significant portion of children exposed to traumatic events develop maladaptive emotional and behavioral reactions, and their development and adaptation mechanisms are disrupted. For this reason, the use of nursing practices that will ensure children's compliance with the procedure during invasive procedures will facilitate children's adaptation to the procedure. Therefore, it is important for trauma nursing to provide accurate and timely nursing care and interventions for the child in trauma so that the child is in complete physical and psychological well-being.

Keywords: Emergency Department, Trauma, Emergency Nursing

1. GİRİŞ

Travma sözcüğü eski Yunancada yara anlamına gelmekte olup kinetic, kimyasal ya da termal enerjinin dokulara transferi ile ortaya çıkan doku hasarı olarak tanımlanmaktadır. T Bu karmaşık olan mekanizmayı tanımlayabilmek tedavi ve bakım sürecini hızlandırmaktadır. Bu bağlamda travmanın meydana geliş mekanizmaları ve etkilerini tanımlayabilmek en önemli adımlardan biridir. Travmalar çocukluk döneminde mortalite ve morbiditenin en yaygın nedenleri arasındadır. Bununla birlikte çocukların erişkinlerden farklı anatomik yapıları ve fizyolojik özellikleri nedeniyle yaralanma durumunda verdikleri yanıtlar da farklı olacaktır. Çocuk acil travma hemşiresi acil müdahale sırasında bu özellikleri göz önünde bulundurmalıdır. Anatomik olarak çocukların baş bölgesinin vücut ölçülerine oranla daha büyük olması, kafa kemiklerinin daha ince olması gibi farklılıklar nedeniyle çocukların çoklu travmalara ve özellikle kafa travmalarına maruz kalma sıklığı daha fazladır. Abdomen koruyan kas ve yağ tabakasının henüz tam gelişmemiş ve ince olması nedeniyle bu bölgedeki organ yaralanmaları da daha sık görülmektedir. Çocuklarda fiziksel olarak travmaya yanıt yaş, travmanın şekli, ciddiyetine göre de farklılıklar göstermektedir.



Öte yandan çocuklarda kompanse edici mekanizmaların varlığı önemli travmalarda bile erken dönemde belirti vermeyebilir. Bunun için travmaya getirilen çocuğun değerlendirmesi yapılırken fiziksel bir bulgu olmasa bile detaylı değerlendirme yapılması oldukça önemlidir (Sönmez Düzkaya ve Kuğuluoğlu; 2012: 441).

YARALANMA ÇEŞİTLERİ

1.1. Yaralanma

Çocukluk dönemi yaralanmaları en yaygın olarak evde, okulda ve sokakta görülmektedir. Çocuklarda en sık yaralanma şekilleri incelendiğinde; düşmeler, motorlu taşıt kazaları, zehirlenmeler, boğulmalar ve yanıklar karşımıza çıkmakta ebeveyn / bakıcı istismarı da travma nedenleri arasında sayılmaktadır. En çok yaralanmalar künt travmalara bağlı gelişmekte ve yine bu dönemde sıklılka görülen omurga – kafa travmalarının da çocukluk çağı mortalitesinde önemli yeri vardır. Penetran travmalar erişkinlere göre çocuklarda daha az görülmektedir. Çocuklarda sıklıkla karşımıza çıkan yaralanmalardan biri olan kafa ve omurga travmaları hayati önem taşımaktadır. Çocukların serebral oksijenizasyon ve perfüzyonu yetişkinlere göre daha iyi kompanse edebildikleri için çocukların benzer travmalı yetişkinlere göre daha hızlı iyileşme gösterdikleri bildirilmektedir. Kafa travmalarından sonra çocuklarda en sık görülen ikinci travma toraks yaralanmaları nedeniyle olmaktadır. Toraks yaralanmaları da çoğunlukla motorlu taşıt kazaları ve istismar nedeniyle görülmektedir. Bununla birlikte çocuklarda yetişkinden farklı olarak vücudun küçük olması nedeniyle toraks yaralanmalarına eşlik eden kafa ya da abdomen yaralanmaları da yaygındır (Sönmez Düzkaya ve Kuğuluoğlu; 2012: 440).

2.1. Kinetik Enerji Kaynakları ve Travmalar

Kinetik enerjinin vücut yapısına aktarılması, künt (iç organların yaralanması), penetran (cilt ve organ bütünlüğüne zarar verme), patlama (ani, kuvvetli, ileri – geri hareket) ve ezilme (vücut yapılarına doğrudan baskı) olmak üzere farklı şekillerde olabilmektedir (Sönmez Düzkaya ve Kuğuluoğlu; 2012: 441). 1-44 yaş aralığındaki ölümlerin en yaygın nedeni travmalar olarak belirtilirken, tüm yaş gruplarında kardiyovasküler hastalıklar ve kanserlerin ardından üçüncü sırada yer almaktadır (MEB, 2017). Gelişmiş ülkelerde ise çocuklar arasındaki ölümlerin başlıca sebebi olarak travmalar öne çıkmaktadır (Kılıç ve ark., 2016: 131-137). Güncel verilere göre, her yıl dünya genelinde yaklaşık 47.000 çocuk düşme nedeniyle hastaneye yatmakta, 45.000 çocuk zehirlenme nedeniyle hayatını kaybetmekte ve 10 milyondan fazla çocuk trafik kazası geçirmekte ancak bu kazalar ölümle sonuçlanmamaktadır. Türkiye'de ise TÜİK'in son verilerine göre, yılda 120.000'den fazla çocuk ev kazaları nedeniyle acil servislere başvurmakta ve 1-4 yaş arası çocuk ölümlerinin %44'ü kazalardan kaynaklanmaktadır (TÜİK, 2010).

2.1.1. Travma Çeşitleri

2.1.1.1. Künt Travmalar

Deri bütünlüğü bozulmadan alttaki organlarda farklı boyutlarda zararla karşımıza çıkan yaralanmalar künt travmalar olarak tanımlanmaktadır. Künt travmaların en sık görülme nedeni trafik kazaları, yüksekten düşme, bisiklet kazaları, kaykay, bebek yürüteçlerinden kaynaklanan yaralanmalar çocuklarda en sık görülen künt yaralanmalar olarak örneklendirebiliriz (Günal, 2020: 216-224). Künt travmalar çocukluk travmasının yaklaşık % 90'ını oluşturmaktadır (Streck vd., 2012: 371-376). Künt travmalarda enerji genellikle altta yatan yapılar tarafından absorbe edildiği için dış yaralanma bulguları yetersiz olabilmektedir.



Bu nedenle çocuklarda potansiyel bir yaralanma durumunda hayati travma olasılığı göz önünde bulundurulmalıdır. Künt travmalar çoğunlukla akselerasyon – deselarasyon (hızlanma - yavaşlama) kuvveti mekanizması ile ortaya çıkmaktadır. Yaralanma sırasında ortaya çıkan aşırı kuvvetlerden dolayı bedensel yaralanmalara da neden olabilmektedir. Yaşamın ilk yıllarında sık görülen sarsılmış bebek sendromu da hızlanma – yavaşlama kuvveti mekanizması ile ortaya çıkan önemli bir travmadır (Sönmez Düzkaya ve Kuğuluoğlu; 2012: 441).

Motorlu Araç Kazaları

Motorlu araç kazaları çocuklar arasında hayati öneme sahip olan en önemli travmalar arasında yer almaktadır. Trafikte yaşanan kazalar arasında ölümlerin yaklaşık % 10' unu oluşturmaktadır. Bu bağlamda kazalar oluşmadan gerekli önlemlerin alınması mortalite ve morbidite sıklığını azaltacaktır. Çocukların ön koltukta çocuk koltuğu ile ya da koltuksuz oturması durumunda kaza anında hava yastıklarının açılması ve çocuğun solunum sisteminin kapanması ile çok ciddi ölümcül sonuçlara yol açabilir. Araç içinde çocuğun mutlaka arka koltukta seyehat etmesi, araç koltuğunun arka koltuğa uygun biçimde monte edilmesi ve çocuğun araç koltuğunda emniyet kemeri takılı olarak seyehat etmesi gerekmektedir. Bu önlemlerin dışında araç içi çocuk kilidinin kullanılması gereklmektedir (Sönmez Düzkaya ve Kuğuluoğlu; 2012: 441).

Düşmeler

Çocukların düşmeleri genellikle önlenebilir travmalar arasında değerlendirilmektedir. Düşmeler, esas olarak yüksekten düşme ve kendi seviyesinden düşme olarak iki gruba ayrılır. Düşme olaylarında, çocuğun yaşı, düşme şekli, düşülen yüksekliğin farklılığı ve düşülen zeminin yapısı gibi değişkenler, mortalite ve morbidite oranlarının farklılık göstermesine neden olmaktadır (Topgül, 2017).

Düşmeler, hastaneye yatış gerektiren yaralanmaların en yaygın nedenidir. Çocuklarda yataktan düşme, yüksek bir merdivenden / kaydıraktan düşme, çocukl istismarı gibi durumlar en yaygın görülenleridir. Düşme sırasında devam eden yaralanmalar künt güçlerden kaynaklanır ve çoğunlukla ekstremiteler, baş ve abdomeni de etkilemektedir. Düşme mesafesi yaralanmanın ciddiyetini belirlemekle birlikte kısa mesafeden düşen çocuklar için mevcut travma hayati önem taşıyabilmektedir. Rapor edilen ciddi bir yaralanmada düşme mesafesi bir metre ya da daha az ise çocuk istismarından şüphelenilmeli ve adli birimler haberdar edilmelidir. Pediatrik kırıklar, düşme sonucu oluştuğunda, yetişkin kırıklarından yapısal olarak farklılık gösterir. Çocukların iyileşme süreci, yetişkinlere kıyasla daha olumlu sonuçlanır, ancak kırık epifiz bölgesine yakınsa ve epifiz etkilenmişse, bu süreç değişkenlik gösterir (Paksoy ve Köse, 2015). Kapalı kırıklar, deri bütünlüğünü bozmadan meydana gelen kemik kırıklarıdır. Bunun aksine, açık kırıklar deri ve deri altı dokunun zarar görmesi sonucu oluşur ve kırık bölgesi veya neden olduğu kanama dış ortamla temas eder. Açık kırıklarda, kapalı kırıklara göre enfeksiyon riski ve kontaminasyon olasılığı daha yüksektir ve iyileşme süreci daha uzun sürebilir (Demirörs vd., 2014: 3-4).

2.1.1.2. Penetran Travmalar

Penetran travmalar delici kesici aletlerin yol açtığı bıçak yaralanmaları, ateşli silah yaralanmaları ve özellikler çocuklarda oyuncak gibi objelerden kaynaklanan yaralanmalardır. Yaralanmanın şiddeti çocuğun yaşına, yaralanmanın meydana geldiği ortama, yaralanma aracının varlığına / yokluğuna bağlı değişiklik göstermektedir.



Çocuk hastalarda penetran travmaların sıklığı düşük olmakla birlikte genellikle yabancı cisim batması ve üzerine düşme (kalem, çatal, bıçak gibi) şeklinde görülmektedir (Altun vd., 2016: 160-162). Yara tedavisinin amacı, yara kenarlarını birleştirerek enfeksiyonları önlemek ve yaranın en iyi şekilde iyileşmesini sağlamaktır. Yara bakımında, deri temizliği ve yaranın hazırlanması, anestezi uygulaması ve yara kapama yöntemleri gibi adımlar bulunmaktadır. Yaranın birincil kapanmasında, dikiş, zımba, yapışkan bantlar ve doku yapıştırıcıları kullanılmaktadır (Erdur vd., 2006: 20-27). Nadiren görülmekle birlikte ateşli silah yaralanmaları, bıçaklanma yaralanmaları da görülebilir. Penetran travmalar nadir görülmekle birlikte mortalite sıklığı ise künt travmalara göre üç kat daha fazladır. Penetran travmaları önlemek için çocukların ağızlarında cisimle (kalem, çatal v.b.) koşmaları, yaş grubuna uygun olmayan tehlikeli oyuncaklarla oynamaları ve demir çit / korkuluklara tırmanmaları önlenmelidir (Sönmez Düzkaya ve Kuğuluoğlu; 2012: 442).

2.1.1.3. Zehirlenmeler

Çocuklarda zehirlenmeler, etkenin, çevrenin ve maddenin bir araya gelmesiyle oluşan, ani ortaya çıkan ve mortalite ile morbiditeye yol açabilen hastalık durumları olarak tanımlanabilir (Güzel ve Teksam, 2014: 55-67). Dünya Sağlık Örgütü'ne (DSÖ) göre, 20 yaş altındaki çocuklar ve gençler arasında her yıl yaklaşık 45.000 akut zehirlenme kaynaklı ölüm meydana gelmektedir. Zehirlenmeler, dünya genelinde özellikle çocukluk çağında acil servislere başvuran hastalar arasında önemli bir yer tutmakta ve zehir danışma merkezlerine bildirilen olguların %50'den fazlasını beş yaş altındaki çocuklar oluşturmaktadır. Özkıyım ve kazalar sonucu meydana gelen zehirlenme vakalarının yıllık oranı gelişmiş ülkelerde %0,02-0,93 arasında değişirken, Türkiye'de bu oran %0,46-1,57 arasındadır (Bozlu ve Kuyucu, 2018: 106-109). Acil servise zehirlenme ile başvuran hastaların durumu, en basit belirtilerden ölümcül seyirli durumlara kadar uzanabilmekte ve bu da zehirlenmeleri daha da önemli kılmaktadır. Toksin maddeyle temas sonrası ortaya çıkan etkiler, belirtiler ve durumun seyri benzeyebilir ancak her zehirlenme vakası kendine özgü olarak değerlendirilmelidir (Güzel ve Teksam, 2014: 55-67).

2.1.1.4. Yanıklar

Yanık, 1sı, elektrik, kimyasal maddeler ve radyoaktif ışınlar nedeniyle meydana gelen doku hasarını ifade eder. Yanıklar, dokuda fizyolojik değişikliklere yol açarak hipovolemi, enfeksiyon, şekil bozuklukları, organ kayıpları ve hatta ölümlerle sonuçlanabilir (Tuna ve Cetin; 2010: 1-12). Bakım alanında önemli gelişmeler kaydedilmesine rağmen, yanıklar hala ölümle sonuclanan travma nedenleri arasında ücüncü sırada ver almakta olup, cocukların %3,9'unun ölümüne yol açmaktadır. Yanık, çocukların fiziksel, duygusal ve sosyal yönlerini olumsuz etkilemektedir (KimLK vd., 2012: 290-295). Yanık vakalarında acil servise başvuran hastalarda öncelikle diğer travma hastalarında olduğu gibi ABC'nin sağlanması gerekmektedir. Ardından yanığa özgü tedaviler uygulanmalı ve rehabilitasyon süreci planlanmalıdır (Yastı vd., 2015: 79-89). Hastanın değerlendirilmesi sırasında yanığın etkilediği bölge, derinliği ve yüzey alanı kontrol edilir. Birinci derece yanıklarda epidermis sağlam kalır, cilt kızarır ve büllöz yapı gözlenmez; etkilenen bölge ağrılıdır. Tedavi sırasında hastanın ağrısının giderilmesi, etkilenen bölgenin nemlendirilmesi ve güneşten korunması önemlidir. İyileşme genellikle 3-4 gün içinde gerçekleşir ve skar dokusu oluşmaz. İkinci derece yanıklar ise iki alt gruba ayrılır. Yüzeyel ikinci derece yanıklarda epidermisin tamamı ve dermisin üst kısmı etkilenebilir. Bu yanıklar kırmızı pembe renkte görünür, kapiller dolumu vardır ve sinir hasarı olmaksızın şiddetli ağrıya neden olur.



Derin ikinci derece yanıklarda ise epidermisin tamamı ve dermisin derin dokuları etkilenmiştir, hastalar genellikle çok ağrı hissetmezler ve bu yanıklar ciddi izler bırakabilir. Üçüncü derece yanıklar tam kat yanıklar olarak adlandırılır ve epidermis, dermis ve cilt altı dokuları etkiler; bu yanıklarda hasta ağrı hissetmez. Dördüncü derece yanıklarda ise fasya, kaslar ve bazen kemikler bile etkilenebilir. Üçüncü ve dördüncü derece yanıkların tedavisinde cerrahi müdahale gerekebilir (Burn Clinical Practice Guideline, 2016).

2.1.1.5. Hava yolu tıkanıklığı / kulak – burun - gis yabancı cisim kaçması

Yabancı cisimler, vücutta bulunmaması gereken maddeler olarak tanımlanabilir ve her yas grubunda farklı yollarla vücuda alınmış yabancı cisimler bulunabilir. Bu yabancı cisimler her hastada riskli komplikasyonlara yol açabilir, ancak çocuklar mortalite ve morbidite açısından daha yüksek risk altındadır. Hava yollarındaki yabancı cisimler özellikle 6 ay ile 3 yas arasındaki çocuklarda ve erkek çocuklarda daha yaygındır. Yapılan çalışmalara göre, yabancı cisim aspirasyonu 3 yaşına kadar olan çocuklarda %60-90 oranında görülmektedir (Özsoylu ve diğerleri, 2017: 43-46). Yabancı cisim aspirasyonu sonrası erken belirtiler arasında ani başlayan öksürük, solunum güçlüğü, hırıltı, siyanoz, konuşamama ve hatta ölüm sayılabilir. Geç başvuru durumunda ise hırıltı, öksürük, sık ve tekrarlayan akciğer enfeksiyonları, bronşektazi gibi belirtiler görülebilir. Hastanın değerlendirilmesinde öykü almak büyük önem taşır, zira ani başlayan öksürüklerde aspirasyon ilk akla gelmesi gereken nedenlerden biridir (Liman ve diğerleri, 2012: 96-103). Yabancı cisim yutma vakaları incelendiğinde, bu vakalar genellikle 5 yaş altındaki çocuklarda yaygındır. Özellikle oral dönemindeki çocuklar en sık risk altındadır (Demirören ve diğerleri, 2014: 205-209). Ağız yoluyla vücuda giren yabancı cisimler görüntüleme vöntemleriyle teşhis edildikten sonra, cismin konumuna göre tedavi planı yapılır. Özofagusta bulunan cisimler endoskopik yöntemle cıkarılırken, mideye ulasan cisimler için spontan çıkışı gözlemlenebilir ve hasta takip edilir. Bu süreçte gelişebilecek komplikasyonlar açısından hastanın takip edilmesi önemlidir (Dereci ve diğerleri, 2015: 234-240). Burun ve kulakta yabancı cisimler, acil servislere ve kulak burun boğaz uzmanlarına sık başvuru nedenlerindendir ve özellikle 0-5 yaş arasındaki çocuklarda daha yaygındır. Kulaktaki yabancı cisimler, kaşıntı, kulak akıntısı, işitme kaybı, kulak çınlaması ve kulak ağrısı gibi geç belirtilerle veya akut dönemde kanama ile kendini gösterebilir. Yabancı cismi çıkarmaya çalışırken hasta veya yakını, kulak zarını zedeleyebilir (Sağlam ve diğerleri, 2014: 373-376). Burundaki yabancı cisimler ise derin nefes alma sırasında aspirasyon riski taşır (Kılıç ve Sakat, 2015: 2065-2072).

3.1. Travmanın Değerlendirimesi

3.1.1. Başlangıç Değerlendirilmesi

Çocuk yaralanmalarının tedavisi multidisipliner bir yaklaşım gerektirir. Çocuk acil servisine kabul edildiğinde, öncelikle bilinç durumu kontrol edilir, ardından hava yolu açıklığı ve servikal vertebra stabilitesi sağlanır. Solunum ve dolaşım değerlendirilerek birinci değerlendirme tamamlanır. İkinci değerlendirme aşamasında, çocuğun öyküsü alınarak baştan aşağı sistematik bir değerlendirme yapılır (Çelik, 2023: 17-21).



3.1.2. Öykü Alma

3.1.2.1.Travmaya ilişkin öykü

Travma nedeniyle acil servise başvuran çocuk hastaların değerlendirilmesinde, acil hemşiresinin; çocuğun ve ailenin süreçte aktif olarak yer almasını sağlamak, çocuk haklarının ihlalinden şüphelenildiğinde bu hakları koruyup sürdürülebilirliğini sağlamak gibi sorumlulukları vardır. Hemşirenin, çocuğun acile kabul edilmesinden itibaren kapsamlı bir öykü alması, fizik muayenesini yapması ve ailenin yaklaşımını değerlendirmesi önemlidir. Ayrıca tedavi ve bakım sürecinde çocuğun ve ailenin katılımını sağlamak, rehabilitasyon sürecinde desteklemek ve gerekli destek sistemlerine yönlendirmek hemşirenin görevleri arasındadır (Yüzer ve diğerleri, 2008: 19-29).

3.1.2.2. Çocuğun genel sağlık öyküsü

Çocuğun daha önceden geçirmiş olduğu hastalık, kronik bir hastalığı olup olmadığı, işitme, görme, gibi desteklerinin varlığı, alerji, kullandığı ilaçlar sorgulanmalıdır (Sönmez ve Kuğuluoğlu; 2012: 442).

3.1.2.3. Aile öyküsü

Çocuğun ve diğer aile üyelerinin daha önce benzer travmalar yaşayıp yaşamadığı değerlendirilmelidir. Çocuk veya kardeşlerin sık sık ev kazaları gibi olaylar yaşadığı durumlarda, istismar veya ihmal şüphesi dikkate alınmalıdır (Sönmez ve Kuğuluoğlu; 2012: 442).

3.1.3. Fiziksel Değerlendirme

a. Yaşam bulguları:

Çocuğun nabzı, kan basıncı, solunumu ve vücut ısısı, ortalama kilosu değerlendirilmelidir. Genel durumu ve değişiklikleri gözlemleyebilmek için vital bulguları sık aralıklarda izlenmelidir (Sönmez ve Kuğuluoğlu; 2012: 442).

b. Hava yolu ve servikal omurga

Ağız içinde yabancı cisim varlığı (sallanan / kırık diş, kusmuk, salya, sakız, Toprak, kan v.b.) değerlendirilir. Aksesuar kasların solunuma katılımı gözlenir. Çocuğa yaşına uygun sorular sorarak sözlü yanıtı akciğer havalanmasının düzeyini değerlendirmemize yardımcı olup gözlemlememizi sağlayacaktır. Fizik muayene sırasında servikal omurgayı hareket ettirmekten kaçınılmalıdır (Sönmez ve Kuğuluoğlu; 2012: 442).

Solunum sistemi:

Çocuklarda, ağız içi organların daha büyük olması nedeniyle hava yolunun açıklığı yetişkinlere göre larenksin görünmesini zorlaştırır. Ayrıca, diyafram 4-5 yaşına kadar çocukların ana solunum kasıdır ve bu da yetişkinlerden farklıdır. Distress durumlarında, çocuklar karbondioksit atılımında yetersizlik yaşadıkları için metabolik asidoz riski altındadır (Ünal ve diğerleri, 2008: 112-115).

Inspeksiyon: Çocuğun yardımcı solunum kaslarını kullanıp kullanmadığı, bilateral göğüs hareketleri incelenir. Laserasyon, kanama, ezilme, ekimoz ve ödem gibi bulgular değerlendirilir. Göğüs kafesi deformasyon, yelken göğüs (kırıklara bağlı) açısından değerlendirilir (Sönmez ve Kuğuluoğlu; 2012: 443).

Bebekler ve küçük çocuklar diyaframdan nefes alıp verdikleri için tam diyafram kasılması olmadığı zamanlarda solunum sıkıntısı olur.



Bunun en sık görülen nedeni çocuğun ağlarken ya da maske yoluyla solunum desteği alırlen hava yutması sonucu oluşan gastrik distansiyondur. Gastrik distansiyon nazogastrik ya da orogastrik tüp yerleştirilip bunu bir aspiratöre bağlamak yoluyla müdahale edilir (Özkan, 2015: 517).

Oskültasyon: solunum hızı ve derinliği izlenir. Anormal solunum sesleri gözlenip değerlendirilir (Sönmez ve Kuğuluoğlu; 2012: 443).

Palpasyon: göğüs kafesi ve kemiğini palpe ederek hassasiyet, deformite, çökme gibi durumlar açısından değerlendirilir (Sönmez ve Kuğuluoğlu; 2012: 443).

Kardiyovasküler sistem:

Inspeksiyon: Dış kanama ya da yaralanma bölgeleri gözlemlenir. Mevcut kanama bölgesi var ise bası uygulanır (Sönmez ve Kuğuluoğlu; 2012: 443).

Oskültasyon: Kalp atımı, ritm, ve hızı değerlendirilir. Genel şok tablosu belirtileri yönünden gözlemlenir (Sönmez ve Kuğuluoğlu; 2012: 443).

Palpasyon: Santral ve peripheral nabız hız, ritim, eşitlik açısından değerlendirilir. Perferal dolaşım (radial / brakial nabzın palpasyonu, cilt rengi, sıcaklığı ve kapiller ger idolum hızı) değerlendirilir (Sönmez ve Kuğuluoğlu; 2012: 443).

Nörolojik sistem:

Sözlü ve ağrılı uyaran ile bilinç düzeyi control edilir. Küçük bebekler, gelişimsel dönemlerine uygun özelliklere göre değerlendirilir (örneğin, altı aylık bir bebekte nesnelere odaklanma ve takip etme gözlemlenirken, üç yaşındaki bir çocuktan sözlü yanıt beklenir). Bilinç değerlendirmesi, çocuklar için modifiye edilmiş Pediatrik Glasgow Koma Skalası kullanılarak gerçekleştirilir. (Sönmez ve Kuğuluoğlu; 2012: 446).

Çocuklar için revize edilmiş Glaskow Koma Skalası Glaskow koma skalası		
Spontan açık (4)	Oryante (5)	Komutlara uyuyor (6)
Sözlü uyarana (3)	Konfüze (4)	Ağrıyı lokalize ediyor (5)
Ağrılı uyarana (2)	Uygunsuz kelimeler (3)	Ağrıyı çekiyor (4)
Açmıyor (1)	Anlamsız sesler (2)	Ağrıya fleksiyon yanıt (3)
	Yanıt yok (1)	Ağrıya ekstansiyon yanıtı (2)
		Yanıt yok (1)

Saç ve saçlı deri: Saçlı deri laserasyon, kontüzyon, termal yaralanma, kanama yönünden değerlendirilir (Sönmez ve Kuğuluoğlu; 2012: 446).

Baş ve boyun: İki yaşından küçük çocuklarda anterior ve posterior fontaneller değerlendirilir. Fontanelin kabarık olması KİBA (kafa içi basınç artışı) riskini akla getirilmelidir. Fontanelde kabarıklık gösteren bütün bebekler, bebek uyanık ve bilinci yerinde olsa da, beyin cerrahisi servisine yönlendirilmelidir, ani kötüye gidişler yaşanabilir. (American College of Surgeons Committee on Trauma, 2008). Palpasyonla hastanın bölgesel duyarlılığı, karotis nabızları, cilt altı amfizemi değerlendirilir. Travma sonrası çocukların kafatası cam, metal, v.b. cisim varlığı açısından incelenir.



Travma sonrası görülebilecek bulgular (ağrı, laserasyon, hematom, ödem, kanama) değerlendirilir. Trakeal deviasyon varlığına bakılır. Boyun inspeksiyonunda hastanın yardımcı solunum kaslarını kullanıp kullanmadığı, boyun venlerinin dolgunluğu değerlendirilir (Sönmez ve Kuğuluoğlu; 2012: 446).

Yüz ve ağız boşluğu: Yüzde çizilme, ekimoz, ödem, asimetrik değerlendirilir. Ağız içinde kesi, kanama, salya, yabancı cisim varlığına bakılır. Dişler kırık ve eksiklik açısından değerlendirilir. Çocuktan gülümsemesi, yüzünü buruşturması ve ağzı açıp kapatması istenir ve değerlendirilir. Maksilla ve mandibulayı palpe ederek hassasiyet ve ağrı yönünden değerlendirilir (Sönmez ve Kuğuluoğlu; 2012: 446).

Kulaklar: hemoraji, BOS drenajı açısından değerlendirilir. Kulak arkasında ekimoz oluşması (battle belirtisi) yönünden izlenir. Bu bulgular ile kafatası kırıklarından şüphelenilir (Sönmez ve Kuğuluoğlu; 2012: 446).

Burun: deformiteler açısından değerlendirilmelidir. Özellikle kafa travmalarında burundan BOS ya da kan gelmesi durumunda çocuk hasta izlenmelidir. Burunda oluşabilecek septal kırık ve hematom mutlaka incelenmelidir (Sönmez ve Kuğuluoğlu; 2012: 446).

Göz ve pupiller: Pupillerin eşitliği, ışığa reaksiyonu değerlendirilir. Pupillerin eşit olmaması kafa içi basınçta artma riskini düşündürmelidir. Konjoktiva ve fundusta hemoraji bulguları izlenir. Göz çevresi ve göz kapaklarında ödem, pitozis, kanama olup olmadığı gözlenir. Görme keskinliği, küçük yaş grubu çocuklar için muayene odasında bulunan bildikleri bir objeyi göstermesi istenerek, daha büyük çocuklar için ise görme netliği sorgulanarak değerlendirilir (Sönmez ve Kuğuluoğlu; 2012: 446).

Abdomen: çocuklarda abdominal yaralanma bir çok mekanizma sonucu ortaya çıkar. Bunlar arasında düşmeler, spor ve bisiklet kazaları ve araba kazaları yer alır (buna uygun olmayan emniyet kemeri sonucu oluşan yaralanmalar da dahildir.) Yaralanmaya eşlik eden anatomik faktörler arasında küçük çocukların daha az adipoz dokuya sahip olması, karın kaslarının tam gelişmemiş olması ve iç organlarının nispeten daha büyük olması sayılabilir. Buna ek olarak, çocukların karaciğer ve dalakları yetişkinlerde olduğu gibi esnek ve kısa göğüs kafesi tarafından korunmamakta ve böbrekler artan mobilite ve daha az yağ sonucu ergen ve yetişkinlere göre daha az koruma altındadır. (Özkan, 2015).

Kas iskelet sistemi :

Bebeklik döneminde kaslar, kuvvet ve koordinasyon açısından yeterince gelişmemiştir. Yetişkinlerde kas ağırlığı vücut kütlesinin %40'ını oluştururken, bebeklerde bu oran %25'tir. Bu nedenle, bebeklerin düşme ve yaralanma riskleri daha yüksektir (Kılıçarslan Törüner, Büyükgönenç 2015.)

Deformite, aşınma, kontüzyon, ödem, açık yara, hematom, kanama ve saplanmış cisim gibi durumlar değerlendirilir. Her bir ekstremite aşınma, kesi, kontraksiyon, ekimoz, kontüzyon açısından gözlenir. Ekstremiteler deformite, hassasiyet açısından gözlenir. Tüm eklemler kontrollü olarak hareket ettirilir ve ağrılı hassas bölgeler tespit edilmeye çalışılır (Sönmez ve Kuğuluoğlu; 2012: 446).

3.1.4. Psikososyal Değerlendirme

Travma ile acil servise gelen çocuğun psikososyal değerlendirilmesinde öncelikle çocuk ve ailenin mevcut durumla baş etme stratejileri belirlenmelidir. Ayrıca çocuk ve ailenin travmanın tedavi ve bakımına ilişkin algısı değerlendirilmelidir (Sönmez ve Kuğuluoğlu; 2012: 446).



4.1. Travmalı çocukta hemşirelik girişimleri

Bir travma hastasının başarılı yönetimi yaralanmaların tanımlanması ve değerlendirme becerilerinin kullanımına bağlıdır. Bu tanılama ve değerlendirme süreci olay öncesi, olay anı ve olay sonrasını kapsamaktadır. Travmanın aşamalarına baktığımızda olay öncesi önlenebilir aşama olup, olayın yaşandığı an enerji değişimi ya da kinematiğin olduğu ve olay sonrası ise mevcut durumun tanılanması ve değerlendirilerek bakım sürecinin başladığı evredir. Çocuk acil hemşiresi çocuğun başlangıç değerlendirmesini ve detaylı öyküsünü aldıktan sonra uygun hemşirelik girişimleri ile bakımı sürdürmelidir (Sönmez ve Kuğuluoğlu; 2012: 446). Travma nedeniyle acil servise başvuran çocuk hastaların değerlendirilmesinde, acil hemşiresinin; çocuğun ve ailenin süreçte aktif olarak yer almasını sağlamak, çocuk haklarının ihlalinden şüphelenildiğinde bu hakları koruyup sürdürülebilirliğini sağlamak gibi sorumlulukları vardır. Hemşirenin, çocuğun acile kabul edilmesinden itibaren kapsamlı bir öykü alması, fizik muayenesini yapması ve ailenin yaklaşımını değerlendirmesi önemlidir. Ayrıca tedavi ve bakım sürecinde çocuğun ve ailenin katılımını sağlamak, rehabilitasyon sürecinde desteklemek ve gerekli destek sistemlerine yönlendirmek hemşirenin görevleri arasındadır (Özakar Akça ve Gözen, 2013.)

ANSTA takibine ilişkin hemşirelik girişimleri: Vital bulgular, hasta prognozundaki olumsuzlukların en erken belirtileridir. Yüksek mortalite riskine sahip hastalarda, klinik bozulmanın erken tanımlanması ile olumlu sonuçlar elde edilebileceği kanıtlanmıştır (Ong ve diğerleri, 2013). Hemşire, hastaların EKG, solunum, SpO2, vücut ısısı ve arteryel kan basıncı gibi parametrelerinin monitorizasyonunu sağlar, bu parametreleri izler, değerlendirir, sonuçlarını kaydeder ve normalden sapmaları hekime bildirir (TC Sağlık Bakanlığı, 2011, Hemşirelik Yönetmeliği).

Hava yolu problemlerine yönelik girişimler: Kafa travması, maksillofasiyal ve boyun yaralanmaları olan çocuklarda hava yolunu koruyamama riski yüksektir (TC Sağlık Bakanlığı, 2019 Hemşirelik Yönetmeliği). Güncel kılavuzlar, travma olgularında hava yolu değerlendirilmesi gerekliliğine vurgu yaparak hemşirelere bu uygulamayı tavsiye etmektedir (Henry, 2018). Ağız içinin kontrol edilmesi önemlidir; kan veya sekresyon gibi maddelerin varlığında ağız içi ve üst solunum yolları aspire edilerek temizlenmelidir. Derin aspirasyondan kaçınılmalıdır, çünkü posterior farinks, larinks veya trakea uyarımı sonucunda bradikardi ve vagal stimülasyon gelişebilir. Hava yolu tıkanıklığına neden olabilecek yüz, trakea veya larenks zedelenmeleri ya da kırıkları değerlendirilmelidir. Hava yolunu açık tutamayan bilinçsiz çocuklara orofarengeal veya nazofarengeal airway takılmalıdır. Ayrıca, mide distansiyonunu ve sınırlı havalanmayı önlemek için orogastrik veya nazogastrik bir tüp yerleştirilmelidir (Sönmez ve Kuğuluoğlu; 2012: 446).

Ağrı ile ilgili girişimler: Travma geçiren hastalarda ağrı yaygın bir bulgudur. Ağrının değerlendirilmesi, izlenmesi, reçetelenen analjeziklerin uygulanması ve hastanın bu analjeziklere tepkisinin kaydedilmesi, hemşirenin ağrı yönetimi konusundaki sorumlulukları arasındadır (Sönmez ve Kuğuluoğlu; 2012: 446).

Servikal omurga stabilizasyonunun değerlendirilmesi ve sürdürülmesi: Servikal omurgayı elle sabit konumda hareketsiz hale getirilmelidir. Servikal omurga stabilizasyonunu korurken bilinçsiz çocuğun ağzını çene itme manevrasıyla açılmalıdır. Omurga hasarını önlemek için ani boyun hareketi ve zorlamadan kaçının. Servikal omurga değerlendirilmesi tamamlanıncaya kadar servikal ve spinal stabilizasyonunu korumalıyız. Yatay servikal hareketi önlemek için havlu ruloları ya da hazır immobilizasyon cihazlar kullanılmalıdır (Sönmez ve Kuğuluoğlu; 2012: 446).



Solunumun değerlendirilmesi ile ilgili girişimler: Hava yolu açıklığından emin olduktan sonra çocuğa oksijen desteği sağlanmalıdır. Solunum yeteneği olan çocuğa maske ile oksijen mutlaka uygulanmalı. Solunum hızı, ritmi, sayısı takip edilmeli ve oksijenasyonun yeterliliğini belirlemek için oksijen saturasyonunu değerlendirmeliyiz. Göğsün ve boynun inspeksiyon, oksültasyon, palpasyonu ve perküsyonunu(trakea deviasyonu, yelken göğüs, penetran göğüs yaralanması, sternum kırığı ve deformiteler v.b.) değerlendirilmelidir. Çabalı ve etkisiz solunum, apne gibi bulgular varsa balon valf maskesi ile yapay havalandırma başlatılmalıdır. Oksijen uygulanmasına rağmen solunumu çabalı ve etkisiz ise çocuk için entübasyon malzemeleri hazır bulundurulmalıdır. Hemotoraks, pnömotoraks ya da hemopnömotoraks şüphesinde torakostomi ve göğüs tüpü yerleştirilmesi için gerekli hazırlıklar yapılmalıdır (Sönmez ve Kuğuluoğlu; 2012: 446).

Dolaşımın değerlendirilmesi ile ilgili girişimler: Vücudun kan ve sıvı kaybına karşı önlem alındığından emin olunmalı, sık aralıklarla bilinç, nabız, kapiller dolum, kan basıncı ve oksijen satürasyonunun izlenmesi oldukça önemlidir. Dış kanamayı kontrol etmek için doğrudan basınç uygulanabilir (bölge için uygun ise). Orta – büyük travma şüphesi olan çocuğa tercihen üst ekstremitelerde, bir ya da iki adet intravenöz kateter takılmalıdır. Şok belirtileri varsa sıvı replasmanı başlatılmalı. Çocuğun aldığı ve çıkardığı sıvı miktarını izleyip kaydını sağlamalıyız. Nabzın düşük ve zayıf olması durumunda kardiyopulmoner resüsitasyon gereksinimini göz önünde bulundurup gerekli hazırlıklar yapılmalıdır (Sönmez ve Kuğuluoğlu; 2012: 446).

Nörolojik fonksiyonların değerlendirilmesi ile ilgili girişimler: kafa içi basıncı (KİB) değerlendirmek için nörolojik değerlendirmeler yapılmalıdır. Bilinç düzeyinde değişiklikler (Glaskow koma skalası, fiziksel değerlendirme), kusma ve sinirlilik, disoryantasyon durumlarına bakılır. Kafa travması ile gelen çocuğun hipovolemik şok bulguları varsa intravenöz sıvı alımını sürdürmeliyiz. Kan basıncının yeterli olması halinde intrakranyal basıncı düşürmek için ozmotik ajanların uygulanması için hazır bulunulmalıdır (Sönmez ve Kuğuluoğlu; 2012: 446).

Termoregülasyonun değerlendirilmesi ile ilgili girişimler: Vücut 15151 değerlendirilmeli ve hipotermi durumlarında pasif 151tma yöntemleri (ortam sıcaklığının arttırılması, 151tma lambalarının uygulanması, 151tıcı battaniyeler gibi) uygulanmalıdır. Hipotermi devamında ise aktif 151nma önlemleri başlatılmalıdır (151tlmış intravenöz 51v1 uygulanması gibi) (Sönmez ve Kuğuluoğlu; 2012: 446).

Çocuk ve ailesine psikososyal destek sağlanması ile ilgili girişimler: Çocukların ve ailenin etrafında sağlık çalışanları olarak, hemşireler yaralı çocuk ve ailelerine psikososyal destek verilmesinde önemli rol oynar. Aileye çocuğu hakkında istendiği düzeyde gerekli ve doğru bilgilendirme yapılmalıdır. Ailenin çocuğuna bilgisayarlı tomografi, tarama ya da radyoloji departmanı gibi diğer bölümlere giderken eşlik etmesini desteklemeliyiz. Şiddet görmüş ya da araç kazası sonucu yaralanmış çocuklarda travma sonrası stres bozukluğu görülme riski oldukça fazla olduğundan aileyi gerekli birimlere doğru şekilde yönlendirme işlemini planlamalıyız (Sönmez ve Kuğuluoğlu; 2012: 446).

SONUÇ ve ÖNERİLER

Acil servise getirilen çocuk hasta travmanın etkisiyle mevcut durumun şokunu üzerinden atamamışken travma odasında sağlık profesyonellerinin ona olumsuz bir şekilde davranması ya da ağrılı işlemlere aniden başlamaları çocuk üzerinde yeni bir psikolojik travma yaratacağından oldukça dikkatli, özverili, açıklayıcı bir dille iletişime geçilmelidir.



Bir yetişkinle değil bir çocuk hasta ile uğraş verildiği asla unutulmamalı ona göre tedbirler alınmalıdır. Son yıllarda yapılan çalışmalar doğrultusunda geliştirilen ve sonuç alınan dikkati başka yöne çekme tekniklerini kullanmak travmalı çocuk hastada tıbbi işlemler sırasında oluşan ağrıyı en aza indirme oldukça önemlidir.

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DOĞUM AĞRISININ YÖNETİMİNDE SU-JOK UYGULAMASI

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ÖZET

Akut bir ağrı olarak bilinen doğum ağrısı karmasık, siddetli ve kontrolü en zor olan ağrı türlerinden biri olarak hissedilmektedir. Bu ağrı türü sonucunda anneyi bebeğine kavuşturan ve sınırlı bir süreyi kapsayan özellikleri ile diğer ağrı türlerinden ayrılmaktadır. Ağrı her bireyin yaşamı boyunca tecrübe ettiği, kişilerin farklı tepkiler ile yanıt verdiği subjektif bir durumdur. İnsan vücudunun işleyişinde bir enerji akımı varlığı kabul edilmektedir. Bu enerji akımının herhangi bir ağrı veya hastalık nedeniyle bozulması el ve ayaklar üzerindeki yansıma bölgelerine sinyaller iletir. Bu uygulama sonrasında ağrı hissedilen bölgede enerji akışının uyarılması ile semptomların giderildiği savunulmaktadır. Güney Koreli Prof. Park Jae Woo tarafından geliştirilmiş olan Su-Jok terapi de Su-Jok kelimeleri el ve avak anlamına gelmektedir. Alternatif ve tamamlayıcı bir terapi tekniği olan Su Jok terapi, doğum ağrısının kontrolünde kullanılabilecek non-farmakolojik ve invaziv olmayan bir yöntem olarak akupunktur felsefesine dayanmakta ve enerji akışını dengelemektedir. Su-jok uygulaması belirli noktalar kullanılarak vücuda rahatlık hissi olusturacak bir masaj terapidir. Herhangi bir yan etkisi olmadığı için gebelerde kullanılabilir bir masaj uygulamasıdır. Doğum ağrısı kontrolü ve baş etmesi zor bir ağrıdır. Özellikle primiparlarda doğum deneyiminin ilk kez yaşanmasına bağlı olarak multigravidalara göre doğum ağrısı daha şiddetli ve yoğun hissedilmektedir. Literatürde Su-Jok terapi girişimsel bir müdahale olmaması, basit uygulanabilir olması nedeniyle hemşireler tarafından doğum ağrısı ile baş etmede daha yaygın kullanılması önerilmektedir. Bu çalışmada Su-jok terapinin literatürde uygulama alanları ve doğum ağrısı ile baş etmede alternatif bir uygulama olarak etkileri sunulacaktır. Anahtar Kelimeler: Doğum ağrısı, Su-jok terapi, primipar, hemşirelik.

SUJOK APPLICATION IN THE MANAGEMENT OF BIRTH PAIN

ABSTRACT

Birth pain, known as acute pain, is felt as a complex, severe and one of the most difficult types of pain to control. As a result of this type of pain, it is distinguished from other types of pain with its characteristics that bring the mother together with her baby and cover a limited period of time. Pain is a subjective condition that every individual experiences throughout their life and to which people respond with different reactions. It is accepted that there is an energy flow in the functioning of the human body. Any disruption of this energy flow due to any pain or disease transmits signals to the reflection areas on the hands and feet. It is argued that the symptoms are eliminated by stimulating the energy flow in the area where the pain is felt after this application. Su-Jok therapy, developed by South Korean Prof. Park Jae Woo, also means hand and foot in Su-Jok therapy.



Su Jok therapy, an alternative and complementary therapy technique, is based on the philosophy of acupuncture as a non-pharmacological and non-invasive method that can be used in the control of birth pain and balances the energy flow. Su-jok application is a massage therapy that will create a sense of comfort in the body by using certain points. Since it has no side effects, it is a massage application that can be used in pregnant women. Labor pain is a pain that is difficult to control and cope with. Especially in primiparous women, labor pain is felt more severely and intensely than in multigravidas due to the fact that the labor experience is experienced for the first time. In the literature, Su-Jok therapy is recommended to be used more widely by nurses in coping with labor pain because it is not an invasive intervention and is easily applicable. In this study, the application areas of Su-Jok therapy in the literature and its effects as an alternative application in coping with labor pain will be presented. **Keywords:** Labor pain, Su-jok therapy, primiparous, nursing.

GİRİŞ

Akut bir ağrı olarak bilinen doğum ağrısı karmaşık, şiddetli ve kontrolü en zor olan ağrı türlerinden biri olarak hissedilmektedir. Bu ağrı türü sonucunda anneyi bebeğine kavuşturan ve sınırlı bir süreyi kapsayan özellikleri ile diğer ağrı türlerinden ayrılmaktadır (Mamuk ve Davas, 2010; Elmalı Şimşek ve Ecevit Alpar, 2019). Ağrı her bireyin yaşamı boyunca tecrübe ettiği, kişilerin farklı tepkilerde bulunduğu subjektif bir olgudur (Elmalı Şimşek ve Ecevit Alpar, 2019). Bireyler ağrıyı hafifletmek için davranışsal ve duyusal olarak farklı girişimlerde bulunmaktadırlar (Gündüz, 2018).

Latin kökenli "poena" ve Yunanca "poine" kelimelerinden gelen ağrı ceza anlamını taşımaktadır (Kocaman, 1994). Türk Dil Kurumu ağrıyı "Sinir uçlarının şiddetli biçimde uyarılmasıyla ortaya çıkan, vücudun herhangi bir yerinde oluşan rahatsızlık hissi; veca" olarak tanımlar (TDK, 2015). Uluslararası Ağrı Araştırmacıları Örgütü ise (IASP-International Association for the Study of Pain) ağrıyı "Mevcut veya potansiyel doku hasarı ile ilişkili hoş olmayan duygusal ve emosyonel deneyim" olarak tanımlamaktadır (Öngel, 2017; Çelik, 2013; Treede, 2018).

Doğum ağrısı farmakolojik ve nonfarmakolojik yöntemler kullanılarak kontrol edilmeye çalışılmakta ve bu kontroller sağlanırken güvenilir, anlaşılması ya da yapılması kolay olan, fetal hemostazın korunmasını hedefleyen uygulamalar tercih edilmektedir (Mamuk ve Davas, 2010).

Ağrı Teorileri

1880'li yıllarda geliştirilmeye başlanan ve en çok bilinen ağrı teorilerinden biri olan kapı kontrol teorisi (KKT); ağrı oluşumunu şu şekilde açıklar:

Kapı kontrol mekanizmaları (spinal kord üzerinde) ağrı geçişini kontrol etmektedir. Kapının açık olması uyarının (ağrının) bilinç düzeyine ulaştığını yani ağrının hissedildiğini, kapı kapalı olması durumunda ise uyarıların bilinç düzeyine ulaşamadığını dolayısıyla ağrının hissedilmediğine dayanmaktadır (Kömürcü, 2014; Gültepe, 2024). KKT ağrının azalmasında kullanılabilmektedir. Deri üzerine yapılan dokunma, akupresör, masaj gibi uygulamalar KKT'nin işlevini açıklayan bazı örnekler olarak verilebilir. Bu uygulamalar ağrıyı kontrol altına alınabilir kılmaktadır (Elmalı Şimşek ve Ecevit Alpar, 2019; Eti Aslan, 2014).

Diğer bir ağrı teorisi ise; Endorfin teorisidir. (Endojen analjezik mekanizmaları) vücudun kendi salgılamış olduğu analjeziklere benzerlik gösteren endorfin hormonu narkotik reseptörlere tutunarak ağrıyı engeller ve bradikinin, histamin salınımlarını baskılayarak ağrının bilinç düzeyine ulaşmasını önler (Elmalı Şimşek ve Ecevit Alpar, 2019).



Transkütanöz Elektriksel Sinir Uyarısı (TENS), akupunktur gibi endorfin artırıcı uygulamalar ile de ağrı kontrolü sağlanabilmektedir (Karasungur, 2024).

Doğum ağrısı yaşayan annenin hem ağrısını kontrol edebilmek hem de doğum ağrısı üzerine annenin memnuniyetini sağlayabilmek için farmakolojik olmayan yaklaşımlar da kullanılabilmektedir. Nonfarmakolojik uygulamalar ağrının duygusal, bilişsel, sosyoekonomik ve davranışsal yaklaşımlarını değerlendirmeyi amaçlamaktadır. Böylelikle hissedilen ağrı algısı değişmekte, kontrol dürtüsü sağlamakta ve anksiyete azalmaktadır. Ağrıyı kontrol edebilmek için nonfarmakolojik uygulamalar tek veya birlikte kullanılabilir. Dikkat dağıtma, TENS, sıcak ve soğuk uygulamalar, akupunktur gibi çevresel, bilişseldavranışsal terapi yöntemleri ağrıyı azaltmayı destekleyen ve farmakolojik olmayan uygulamalar arasında yer almaktadır (Elmalı Şimşek ve Ecevit Alpar, 2019; Demir Dikmen, 2013; Yavuz, 2014).

Literatür taramalarında, Su-Jok terapinin girişimsel müdahaleleri içermemesi ve yan etki oluşturmaması, ayrıca basit bir uygulama biçimine sahip olması sebeplerine bağlı olarak hemşirelerin Su Jok terapi uygulamasının desteklenmesi savunulmaktadır (Nurjannah, 2020; Kahraman ve Çevik Akyıl, 2022).

1986 yılında Güney Koreli Profesör Park Jae Woo (1942-2010) tarafından geliştirilen "Su-Jok" Kore dilinde el ve ayak anlamını taşımaktadır (Kahraman ve Çevik Akyıl, 2022; Friman ve Chelala,2016; Ivanov 2018; Woo 1987, 1991, 2000, 2002, 2007). Su Jok terapi yansıma noktalarına (el ve ayakta) masaj, ısıtma, tohum ile çeşitli teknikler kullanılarak yapılan modern akupresür/akupunktur yöntemi olarak kullanılmaktadır (Albert ve Asanova, 2016; Albert, 2018; Ivanov 2018; Ponni, 2011; Woo, 2010).

İnsan vücudunun her bir bölgesi diğer bölgelerle bir uyum ve işbirliği içerisinde çalışmaktadır. Böylece vücudun bütünlük halinde birbirlerini etkileyerek devamlılık sağladığı belirtilmektedir (Elmalı Şimşek ve Ecevit Alpar, 2019).

Su-Jok terapinin temelinde; integratif yaklaşımlar, enerji akışı ve enerji kanalları (meridyenler) yer almaktadır (Ivanov 2018; Seth, 2013). İnsan evrenin bir parçası olarak görülmektedir. Evrende var olan enerjinin, insanın içinde de olduğu düşüncesi vardır. İnsan vücudunun kendini onarmasını sağlayan bir güç bulunur ve bu gücün tetiklendiği belirli uyarılma noktaları mevcuttur. Bu noktalar uyarılarak enerji akışının sağlıklı sürdürülmesi sağlanmaktadır (Elmalı Şimşek ve Ecevit Alpar, 2019).

Su-Jok Terapi Etki Mekanizması

Vücudun işleyişinde bir enerji akımı varlığı söz konusudur. Bu enerji akımının herhangi bir ağrı veya hastalık oluşumu nedeniyle bozulması el ve ayaklar üzerindeki yansıma bölgelerine sinyaller iletir (Ivanov, 2018). Yansıma noktaları üzerinde "bilye uygunluğu" olarak tanımlanan ve basınç uygulandığında duyarlılık gösteren minik şişlikler oluşmaktadır. Bu uygulama sonrası ağrı hissedilen bölgenin enerji akışının uyarıldığı, semptomların gerilediği belirtilmektedir (Kahraman ve Çevik Akyıl, 2022; Elmalı Şimşek ve Ecevit Alpar, 2019).

Su-jok terapisinin en temel adımı doğru noktanın tespitidir (Friman ve Chelala, 2016). Vücuttaki enerji akışı, üzüntü-stres gibi nedenlerden olumsuz etkilenir ve tıkanabilir. Bu tıkanma kişinin baş, vücut, el ve ayaklarına şişlik, ağrı veya kalınlaşmış bölgeler olarak yansımaktadır (Tuğay,2010). Uzuvlara yansıyan bu bölgelerde basınç uygulanarak ağrı ve çekilme hissi meydana gelir böylece doğru nokta tespiti sağlanır (Seth, 2013; Woo 1987, 1991, 2000, 2002, 2007).

Kullanım kolaylığı açısından ayaklardan çok eller tercih edilmektedir. Daha çok kadınlarda sağ el, erkeklerde ise sol el kullanımının etkili olduğu görülmüştür.



Ancak temsil edilen organın olduğu bölgenin uygulamada kullanılması daha etkin bir sonuç vermektedir (Ivanov, 2018).

Alternatif ve tamamlayıcı bir terapi tekniği olan Su-Jok terapi, doğum ağrısının kontrolünde kullanılabilecek nonfarmakolojik bir yöntem olarak görülmektedir. Anne ve bebeğin sağlığının korunabilmesi için nanfarmakolojik uygulamalar önem arz etmektedir. Doğum ağrısı kontrolü ve baş etmesi zor bir ağrıdır (Sukmaningtyas ve Wilis, 2016; Asmara, 2022). Özellikle primiparlarda doğum deneyimi yaşamamasına bağlı olarak multigravidalara göre doğum ağrısı daha şiddetli ve yoğun hissedilmektedir. Bunun sebebi, silinme ve servikal dilatasyonun multigravidalarda aynı anda olurken, primigravidalarda silinmenin genel olarak servikal dilatasyondan daha önce gerçekleşmesidir. Bu süreç doğum ağrısının şiddet ve yoğunluğunun multiparlara göre daha zorlu geçmesine neden olur. İlk kez doğum yapacak anneler için stres ve kaygıyı da meydana getirir (Handayani, 2022). Su-jok terapi ile ağrının kontrolünün sağlanması alerjik reaksiyona sebep olmaz ve doğum süresini yavaşlatmaz (Asmara, 2022).

Su-Jok terapi, Rusya Sağlık Bakanlığı tarafından 2000 yılında kabul görmüş bir refleksoterapi yöntemidir. Birçok ülkede aktif olarak uygulanmaktadır (Ivanov, 2018; Safonov ve Naprienko, 2017; Kahraman ve Çevik Akyıl, 2022).

Literatüre bakıldığında; sınırlı sayıda çalışma mevcuttur fakat uygulamalar sonucunun olumlu etkileri belirtilmektedir. Anksiyete yaşayan kişilere uygulanan Su-Jok yönteminin endişe ve kavgı üzerinde azalma sağladığı Hidalgo tarafından belirtilmiştir (Hidalgo, 2012). 100 aştım hastalığı olan çocuklar (7-17 yaş arası) üzerinde yapılan bir çalışmada, yalnızca ilaç kullanan grup ile Su-Jok ve ilaç kullanımının beraber olduğu grup kıyaslanmış sonucunda kombine grubun tedavisinin daha etkili olduğu tespit edilmiştir (Nedeljkovic, 2008). Başka bir calısmada; sistitli bir hastanın bir hafta süre icerisinde Su Jok terapisi almasının sistit semptomlarını gerilettiği belirtilmiştir (Vieira ve ark., 2017). Şiddetli diz ağrısı yaşayan 65-69 yaş aralığındaki kişilere uygulanan Su Jok terapinin ağrı düzeyinde önemli ölçüde azalmalar tespit edilmiştir (Perez ve ark., 2014). Hidrosalpinks tanılı 20 yaş ve üzeri 56 hastanın 10 gün boyunca süren ve 3 kürden oluşan (her kür arasında 15 gün ara ile) Su-Jok terapi uygulamasının pelvik ağrısı üzerinde azalma sağladığı belirtilmiştir (Oliva ve ark., 2017). Topuk dikeni rahatsızlığı olan ve fizik tedavi alan hastaların kontrol ve çalışma grubu olarak ikiye ayrıldığı çalışmada, Su-Jok terapi öncesi ağrıların homojen olduğu belirtilmiş olup, Su-Jok terapi sonrası ise ağrılarında azalma ve iyilesme yönünde olumlu etkiler görüldüğü, ayrıca memnuniyet açısından değerli sonuçlar elde edildiği saptanmıştır (Huber ve ark., 2016). Su-Jok terapi alan, gerilim tipi baş ağrısı yaşayan 50 hastanın terapi sonrasında ağrı şiddetinde ve sıklığında hafiflemenin olduğu belirtilmiştir (Cruz ve Muñoz, 2012). Dismenore üzerine, haftada bir defa avuç içerisine 15 dakika boyunca uygulanan Su-Jok terapinin ağrıyı azaltmada etkili olduğu Siti Aulia Salsabilad ve arkadaşları tarafından tespit edilmiştir (Asmara, 2022). Ağrı ile ilişkili çalışmalar neticesinde; karpal tünel sendromu, periartrit ve cerrahi operasyonlar sonrası oluşan ağrının azalmasında Su-Jok terapinin etkinliği olduğu, hemsirelik uygulaması içerisinde yer almasının desteklenmesinin olumlu sonuçlar elde edileceğini belirtilmektedir (Kahraman ve Çevik Akyıl, 2022; Elmalı Şimşek ve Ecevit Alpar, 2019).

SONUÇ

Doğum ağrısı şiddeti yüksek hissedilen, aynı zamanda subjektif olmasından dolayı birçok faktör tarafından etkilenen bir ağrı türüdür. Yaşam kalitesini düşüren ağrı hissi kişiye özel olduğundan ağrıyı azaltmaya yönelik uygulanan yöntemlerde çeşitlilik göstermektedir.



Su-Jok terapi diğer tedavi şekillerinin önüne geçmeyi değil, farmakolojik ya da nonfarmakolojik uygulamaların eşliğinde verilebilir bir terapi yöntemidir. Su-Jok uygulaması mevcut tedavileri destekleyerek kişide rahatlama ve kontrol edebilme gücü oluşturacağından verilen bakımı da destekleyecektir. Destekleyici bakım etkinliklerinin artırılması ve bakım hizmeti sunarken Su-Jok terapiye yer verilmesi önerilmektedir.

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ÖZET

İnflamatuar Barsak Hastalıkları (İBH), gastrointestinal sistemde nedeni tam olarak bilinmeyen kronik ve tekrarlayan inflamasyon süreçleri ile karakterize edilen bir hastalık grubudur. Crohn Hastalığı ve Ülseratif Kolit, en sık görülen alt tipler olup, yaşam kalitesini olumsuz yönde etkileyen fiziksel semptomlar ve psikososyal sorunlarla ilişkilidir. İBH'nin yönetimi, multidisipliner bir yaklaşım gerektirirken, hemşirelerin rehberlik rolü hastaların semptomlarını yönetmesi, tedaviye uyum sağlaması ve yasam kalitesini artırması açısından kritik öneme sahiptir. Hemsireler, semptom vönetimi, beslenme danışmanlığı, psikososyal destek ve hasta eğitimi gibi alanlarda aktif rol alarak bireyselleştirilmiş bakım planları oluşturmaktadır. Özellikle beslenme yönetimi, psikososyal destek ve hasta eğitimi stratejileri, hastaların semptomlarını hafifletmekte ve tedaviye uyumu artırmaktadır. Ayrıca, sağlık teknolojilerinin kullanımı, mobil sağlık uygulamaları ve tele-sağlık hizmetleri, hasta takibini kolaylaştırarak tedavi süreçlerini iyileştirmektedir. Psikososyal destek hizmetleri, hastaların stres yönetimi, depresyon ve anksivete ile başa çıkmasına yardımcı olarak yaşam kalitesini olumlu yönde etkilemektedir. Ayrıca, destek grupları ve danışmanlık hizmetleri, hastaların sosyal izolasyonunu azaltmakta ve ruhsal dayanıklılıklarını artırmaktadır. Hemşireler, hasta eğitimi ve toplumsal farkındalığın artırılmasında kritik bir rol oynayarak, sosyal damgalamayı azaltmakta ve hastaların tedaviye daha iyi uyum sağlamasına katkıda bulunmaktadır. Bu derleme, İBH yönetiminde hemşirelik rehberliğinin önemini vurgulamakta ve gelecekteki çalışmalar için yol gösterici bir perspektif sunmaktadır. Multidisipliner ekip çalışması, bireyselleştirilmiş bakım planlarının oluşturulması ve dijital sağlık uygulamalarının entegrasyonu, İBH hastalarının yaşam kalitesini artırmada etkili stratejiler olarak öne çıkmaktadır. Bu bağlamda, hemşirelerin eğitim ve danışmanlık rollerinin güçlendirilmesi, İBH yönetiminde kritik öneme sahiptir.

Anahtar Kelimeler: İnflamatuar Barsak Hastalıkları, Crohn Hastalığı, Ülseratif Kolit, Hemşirelik Yönetimi, Hasta Eğitimi.



THE GUIDANCE ROLE OF THE NURSE IN INFLAMMATORY BOWEL DISEASES

ABSTRACT

Inflammatory Bowel Diseases (IBD) are a group of chronic and recurrent inflammatory disorders affecting the gastrointestinal system, with unknown etiology. Crohn's Disease and Ulcerative Colitis are the most common subtypes, associated with physical symptoms and psychosocial issues that negatively impact the quality of life. The management of IBD requires a multidisciplinary approach, and the guiding role of nurses is critical for symptom management, treatment adherence, and enhancing patients' quality of life. Nurses actively participate in symptom management, nutritional counseling, psychosocial support, and patient education, creating individualized care plans tailored to patients' needs. Specifically, nutritional management, psychosocial support, and educational strategies help alleviate symptoms and improve treatment adherence. Additionally, the utilization of health technologies, such as mobile health applications and tele-health services, facilitates patient follow-up and enhances treatment processes. Psychosocial support services assist patients in managing stress, depression, and anxiety, thereby positively impacting their quality of life. Moreover, support groups and counseling services reduce social isolation and strengthen psychological resilience. Nurses play a crucial role in patient education and raising public awareness, which helps reduce social stigma and improves patients' compliance with treatment. This review highlights the importance of nursing guidance in the management of IBD and provides a guiding perspective for future research. Multidisciplinary teamwork, individualized care plans, and the integration of digital health applications are effective strategies for improving the quality of life of IBD patients. In this context, strengthening the educational and counseling roles of nurses is essential for effective IBD management.

Keywords: Inflammatory Bowel Diseases, Crohn's Disease, Ulcerative Colitis, Nursing Management, Patient Education.



TÜBERKÜLOZ OLAN BİREYLERDE YAŞAM KALİTESİ VE HEMŞİRELİK DESTEK HİZMETLERİNİN ETKİSİ

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ÖZET

Bu derleme, tüberkülozun fiziksel, psikososyal ve ekonomik etkilerinin bireylerin yaşam kalitesini nasıl etkilediğini ve hemsirelik destek hizmetlerinin bu etkileri hafifletmedeki rolünü değerlendirmeyi amaçlamaktadır. Tüberküloz, kronik yorgunluk, solunum güçlüğü, kilo kaybı gibi fiziksel semptomların yanı sıra sosyal damgalama, depresyon ve anksiyete gibi psikososyal sorunlara yol açarak hastaların yaşam kalitesini olumsuz yönde etkilemektedir. Bu durum, tedavive uyumu zorlastırmakta ve hastaların genel sağlık durumunu olumsuz etkilemektedir. Hemsirelik destek hizmetleri, doğrudan gözetimli tedavi, psikososyal destek ve hasta eğitimi gibi müdahalelerle tedaviye uyumu artırmakta, sosyal damgalamayı azaltmakta ve yaşam kalitesini iyileştirmektedir. Özellikle, doğrudan gözetimli tedavi uvgulamaları, hastaların ilaçlarını düzenli kullanmasını sağlayarak tedavi sürecini etkin bir şekilde yönetmelerine katkıda bulunmaktadır. Ayrıca, psikososyal destek hizmetleri, hastaların stres yönetimi, depresyon ve anksiyete ile başa çıkmalarını kolaylaştırarak ruhsal dayanıklılıklarını güçlendirmektedir. Tüberküloz yönetiminde hemşirelerin rehberlik rolü, valnızca semptom kontrolü sağlamaktan ibaret olmayıp, aynı zamanda hasta eğitimi, sosyal destek mekanizmalarının güçlendirilmesi ve toplumsal farkındalığın artırılması gibi kritik görevleri de kapsamaktadır. Hemşirelerin etkili iletişim becerileri ve sürekli izleme faaliyetleri, hastaların tedavi motiyasyonunu artırmakta ve tedaviye bağlılıklarını güçlendirmektedir. Toplumsal farkındalığın artırılması ve sosyal damgalamanın önlenmesi amacıyla düzenlenen eğitim programları, hastaların tedaviye katılımını olumlu yönde etkileyerek genel iyilik hallerini iyileştirmektedir. Bu derleme, tüberküloz hastalarının yaşam kalitesini artırmak için multidisipliner bir yaklaşım benimsenmesi ve hemşirelik destek hizmetlerinin güçlendirilmesi gerektiğini vurgulamaktadır. Gelecekteki çalışmaların, hemşirelik müdahalelerinin etkinliğini daha kapsamlı bir şekilde değerlendirecek şekilde tasarlanması önerilmektedir.

Anahtar Kelimeler: Tüberküloz, Yaşam Kalitesi, Hemşirelik Destek Hizmetleri, Psikososyal Destek, Doğrudan Gözetimli Tedavi.

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THE IMPACT OF NURSING SUPPORT SERVICES ON QUALITY OF LIFE IN INDIVIDUALS WITH TUBERCULOSIS

ABSTRACT

This review aims to evaluate how the physical, psychosocial, and economic effects of tuberculosis influence the quality of life of individuals and the role of nursing support services in alleviating these effects. Tuberculosis negatively impacts patients' quality of life by causing physical symptoms such as chronic fatigue, respiratory distress, and weight loss, as well as psychosocial issues like social stigma, depression, and anxiety. These adverse effects hinder treatment adherence and negatively affect the overall health status of patients. Nursing support services, including directly observed therapy, psychosocial support, and patient education, enhance treatment adherence, reduce social stigma, and improve the quality of life. Specifically, directly observed therapy ensures patients take their medications regularly, contributing to the effective management of the treatment process. Additionally, psychosocial support services help patients cope with stress, depression, and anxiety, thereby strengthening their psychological resilience. The guiding role of nurses in tuberculosis management is not limited to symptom control but also involves critical tasks such as patient education, strengthening social support mechanisms, and increasing public awareness. Effective communication skills and continuous monitoring by nurses enhance patients' motivation for treatment and strengthen their adherence to therapy. Educational programs designed to increase public awareness and prevent social stigma positively impact patients' participation in treatment, thereby improving their overall well-being. This review emphasizes the need for a multidisciplinary approach to enhance the quality of life for tuberculosis patients and highlights the importance of strengthening nursing support services. It is recommended that future studies be designed to comprehensively evaluate the effectiveness of nursing interventions.

Keywords: Tuberculosis, Quality of Life, Nursing Support Services, Psychosocial Support, Directly Observed Therapy.



POLİTEKNİK EĞİTİM ÜZERİNE MARKSİST PERSPEKTİFLER: TEORİ VE PRATİK ARASINDA KÖPRÜ KURMAK

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ÖZET

Marksist teori ile politeknik eğitim arasındaki bağlantıyı araştıran bu çalışma, Marksist çerçevelerin eğitim ortamının kapitalist yapılarla iç içe geçmesine dair nasıl önemli içgörüler sağladığını göstermektedir. Politeknik kurumların titiz bir analizi yoluyla, sınıfsal tabakalaşmayı sürdürme ve egemen ideolojileri pekiştirme kanalları olarak işlevlerini vurgulamaktadır. Gizli müfredatı, kurumsal mimarileri ve sosyo-ekonomik bağlamları inceleyerek, politeknik eğitimde dönüştürücü müdahaleler için zorlukların ve beklentilerin karmaşık diyalektiğini ortaya koymaktadır. Marksist sınıf karşıtlığı, ideolojik hegemonya ve toplumsal yeniden üretim ilkelerine dayanan söylemimiz, kapitalist hegemonyaya meydan okuma ve sosyal adaleti sağlamada kolektif seferberlik, eleştirel pedagoji ve yenilikçi eğitim paradigmalarının zorunluluklarını vurgulamaktadır. Politeknik kurumlarının bir yandan çeşitlilik, eşitlik ve kapsayıcılık ilkelerine öncelik verirken, diğer yandan da özünde eşitlikçi, adil ve özgürleştirici bir eğitim ortamı tasavvur etmek için öncü metodolojiler ve işbirlikçi çabalar benimsemeleri gerektiğini vurgulamaktadır. Çalışma boyunca ortaya konan argümanlar, Marksist perspektiflerin teorik temeller ile pratik uygulamalar arasında simbiyotik bir iliski kurulmasındaki ve politeknik eğitimin etik ve dönüstürücü zorunluluklarla dolu bir geleceğe doğru yönlendirilmesindeki önemli rolünün altını çizmektedir.

Anahtar Kelimeler: Kapitalist yapılar, Marksist teori, politeknik eğitim, toplumsal yeniden üretim, dönüştürücü değişim.

MARXIST PERSPECTIVES ON POLYTECHNIC EDUCATION: BRIDGING THEORY AND PRACTICE

ABSTRACT

By exploring the link between Marxist theory and polytechnic education, this study shows how Marxist frameworks provide important insights into the intertwining of the educational environment with capitalist structures. Through a rigorous analysis of polytechnic institutions, it highlights their function as channels for maintaining class stratification and reinforcing dominant ideologies. By examining hidden curricula, institutional architectures and socioeconomic contexts, he reveals the complex dialectic of challenges and prospects for transformative interventions in polytechnic education. Drawing on Marxist principles of class antagonism, ideological hegemony and social reproduction, our discourse highlights the imperatives of collective mobilisation, critical pedagogy and innovative educational paradigms in challenging capitalist hegemony and achieving social justice. It emphasises the need for polytechnic institutions to prioritise the principles of diversity, equity and inclusion while adopting pioneering methodologies and collaborative efforts to envision an inherently egalitarian, just and emancipatory educational environment.



The arguments made throughout the paper underscore the important role of Marxist perspectives in establishing a symbiotic relationship between theoretical foundations and practical applications, and in guiding polytechnic education towards a future full of ethical and transformative imperatives.

Keywords: Capitalist structures, Marxist theory, polytechnic education, social reproduction, transformative change.

GİRİŞ

Marksist ideoloji, eğitim alanı da dahil olmak üzere insan düşüncesi ve pratiğinin çeşitli alanları üzerinde derin bir etkiye sahip olmuştur. Karl Marx ve Friedrich Engels'in çalışmalarından doğan Marksist teori, sosyal yapıları, güç dinamiklerini ve sosyal değişimin gerçekleştiği mekanizmaları anlamak için kritik bir çerçeve sunmaktadır (Cole, 2007, s.17). Genellikle ekonomik sistemlerin ve sınıf mücadelelerinin analiziyle ilişkilendirilse de Marksist perspektifler eğitim kurumlarının işleyişinin ve bireyler ile toplumları şekillendirmedeki rollerinin incelenmesinde de etkili olmuştur.

Bu makale, Marksist teori ile politeknik eğitim arasındaki kesişimleri incelemeyi amaçlamaktadır. Pratik becerilere ve mesleki eğitime verdiği önemle öne çıkan politeknik eğitim, birçok ülkede çağdaş eğitim manzarasının önemli bir yönünü temsil etmektedir. Politeknik eğitimi Marksist bir mercekten inceleyerek, eğitimin daha geniş toplumsal eşitsizlikleri ve iktidar yapılarını yansıtma ve sürdürme biçimlerine dair daha derin kavrayışlar ortaya çıkarmayı amaçlıyoruz.

Marksist düşüncenin politeknik eğitim üzerindeki etkilerini anlamak için Marksist teorinin temel ilkelerini kavramak zorunludur. Marksist analizin merkezinde, tarihin üretim araçları üzerindeki kontrol için mücadele eden farklı sosyal sınıflar arasındaki çatışmalar yoluyla ortaya çıktığını öne süren sınıf mücadelesi kavramı yer almaktadır (Althusser, 2006, s. 56). Toplumsal değişimin bu diyalektik anlayışı, politeknik okullar da dahil olmak üzere eğitim kurumlarının dinamiklerini inceleyebileceğimiz bir mercek sağlar.

Ayrıca, Marksistler ideolojinin mevcut toplumsal hiyerarşilerin sürdürülmesi ve meşrulaştırılmasındaki rolünü vurgulamaktadır. Politeknik kolejler de dahil olmak üzere eğitim kurumları tarafsız varlıklar değil, egemen ideolojilerin aktarıldığı ve yeniden üretildiği yerlerdir (Apple, 2012, s.81). Bu açıdan bakıldığında, politeknik eğitim, egemen toplumsal normları ve yapıları pekiştiren ve böylece sınıf, toplumsal cinsiyet, ırk ve diğer baskı eksenleri boyunca eşitsizlikleri sürdüren bir mekanizma olarak görülebilir.

Tarihsel olarak, politeknik eğitimin ortaya çıkışı 18. ve 19. yüzyıllardaki sanayi devrimlerine kadar uzanmaktadır. Toplumlar hızlı bir sanayileşme ve teknolojik ilerleme döneminden geçerken, gelişmekte olan endüstrilere katkıda bulunabilecek vasıflı işçilere acil ihtiyaç duyulmuştur. Politeknik kurumları bu talebe bir yanıt olarak ortaya çıkmış ve mühendislik, imalat ve tarım gibi alanlarda uygulamalı eğitim sunmuştur (Ronan, 1983, s. 302).

Bununla birlikte, politeknik eğitim görünürde bireyleri giderek sanayileşen dünyada başarılı olmak için gereken becerilerle donatmayı amaçlasa da Marksist akademisyenler bunun altında yatan amacın genellikle sermayenin çıkarlarına hizmet etmek ve mevcut iktidar yapılarını sürdürmek olduğunu savunmaktadır. Politeknik eğitim, işçileri güçlendirmek ve gerçek bir toplumsal seferberliği teşvik etmek yerine, pek çok durumda sınıfsal bölünmeleri yeniden üretmeye ve sömürü sistemlerini sürdürmeye hizmet etmiştir.

Bu düşünceler ışığında, bu makale politeknik eğitimin vaatlerini ve tuzaklarını Marksist bir perspektiften eleştirel bir şekilde incelemeyi amaçlamaktadır.



Eğitim kurumlarını şekillendiren sosyoekonomik güçleri ve bunların daha geniş kapitalist birikim ve sınıf mücadelesi süreçleriyle kesişme yollarını sorgulayarak, daha eşitlikçi ve özgürleştirici bir eğitim biçimine giden yolları aydınlatmayı umuyoruz.

Teorik kavrayışları tarihsel bağlam ve güncel ampirik kanıtlarla bütünleştiren bir analiz yoluyla, politeknik eğitim sistemlerindeki karmaşık dinamiklere ışık tutmayı amaçlıyoruz. Bunu yaparken, derin küresel dönüşümlerin ve zorlukların damgasını vurduğu bir çağda eğitimin sosyal adaleti, ekonomik eşitliği ve insan özgürlüğünü teşvik etmedeki rolünü çevreleyen süregelen tartışmalara katkıda bulunmayı amaçlıyoruz.

Eğitimde Marksist Kuramın Temelleri

Marksist teori, kapitalist toplumlarda eğitimin rolünü analiz etmek için derin ve kapsamlı bir çerçeve sunmaktadır. Marksist analizin merkezinde, toplumun ekonomik temelinin- üretim tarzı ve üretim ilişkileri- sosyal ve politik üstyapıyı belirlediğini öne süren tarihsel materyalizm kavramı yer alır. Eğitim alanında tarihsel materyalizm, eğitim kurumlarının tarafsız varlıklar olmadığını, belirli bir toplumda hüküm süren ekonomik ilişkilerle derinden iç içe geçtiğini savunur. Okullar, kolejler ve üniversiteler tarafsız öğrenme alanları olmaktan ziyade, egemen ekonomik sistemin sürdürülmesine ve yeniden üretilmesine hizmet ederler (Kaygısız, 1997).

Marksist teorinin merkezinde, toplumun ekonomik tabanı ile kültürel ve ideolojik üstyapısı arasındaki ilişkiyi açıklayan temel-üstyapı modeli yer alır. Taban, üretimin maddi güçlerini ve üretimin toplumsal ilişkilerini içerirken, üstyapı eğitim, din, hukuk ve siyaset gibi kurumları içerir. Bu modele göre üstyapı, egemen sınıfın çıkarlarını yansıtır ve güçlendirir ve mevcut toplumsal düzenin sürdürülmesine hizmet eder. Eğitim bağlamında üstyapı, eşitsizliğin ideolojik gerekçelerini aktarma ve toplumsal üretim ilişkilerini yeniden üretme işlevi görür (Demirtaş & Özer, 2015).

Toplumsal ilişkilerin yeniden üretimi, Marksist teorideki bir diğer kilit kavramdır ve sosyalleşme ve kültürel aktarım süreçleri yoluyla mevcut toplumsal hiyerarşilerin ve iktidar yapılarının sürdürülmesini ifade eder. Eğitim kurumları, öğrencilere kapitalist değerleri, normları ve becerileri aktararak kapitalizmin toplumsal ilişkilerinin yeniden üretilmesinde önemli bir rol oynamaktadır. Gizli müfredat- okulun yapısı ve kültürü aracılığıyla verilen enformel dersler- aracılığıyla öğrenciler, kapitalist üretim ilişkilerine elverişli rekabet, bireycilik ve otoriteye itaat değerlerini içselleştirirler (Apple,1984, s. 81).

Dahası, Marksistler egemen sınıfın hakimiyetini sürdürmede ideolojinin rolünü vurgularlar. Mevcut güç ilişkilerini doğallaştıran ve meşrulaştıran bir dünya görüşünün yayılması olan ideolojik hegemonya, egemen sınıfın hegemonyasını sürdürdüğü kilit bir mekanizmadır. Okullar, egemen sınıfın çıkarlarına hizmet eden baskın kültürel anlatıları, tarihleri ve değerleri yaydığı için eğitim, ideolojik hegemonyanın yeniden üretilmesi için birincil bir alan olarak hizmet eder. Eğitim kurumları, kapitalist toplumsal ilişkileri doğal, kaçınılmaz ve faydalı olarak sunarak kapitalist hegemonyanın sürdürülmesine katkıda bulunur (Kale & Nur, 2016). Bu bağlamda Marx'ın (1980, s. 106) ifadesi öne çıkmaktadır: "Egemen sınıfın fikirleri her çağda egemen fikirlerdir".

Burjuva eğitiminin eleştirisi, Marksist eğitim analizinin merkezinde yer alır. Kapitalist toplumsal ilişkilerin yeniden üretilmesindeki ve eşitsizliklerin sürdürülmesindeki rolüyle karakterize edilen burjuva eğitimi, egemen sınıfın çıkarlarına hizmet eder. Marksistler, burjuva eğitiminin bireyleri kapitalist hiyerarşi içindeki ikincil konumlarını kabul etmeleri için sosyalleştirirken, aynı zamanda egemen sınıfın otoritesini meşrulaştırma işlevi gördüğünü savunurlar.



Dahası, burjuva eğitimi eleştirel düşünme, yaratıcılık ve özgürleştirici bilinç pahasına kapitalist üretimle ilgili teknik beceri ve bilgilerin aktarılmasına öncelik verme eğilimindedir (Kesik, 2014).

Bu temel kavramları genişleterek, Marksist teorinin eğitimdeki dinamik ve diyalektik doğasını kabul etmek çok önemlidir. Marksist akademisyenler, bu temel kavramları çağdaş eğitim bağlamlarına uygulayarak ve uyarlayarak süregelen tartışmalara ve analizlere katılmaktadır. Örneğin, Marksizm ile eleştirel pedagoji, eko-Marksizm ve sömürgecilik karşıtı teori arasındaki kesişimleri araştıran son çalışmalar, iklim değişikliği, neoliberalizm ve ırksallaştırılmış kapitalizm gibi küresel krizler karşısında dönüştürücü eğitim olanaklarına dair yeni içgörüler sunmaktadır.

Sonuç olarak, Marksist teorinin eğitim alanındaki temelleri, eğitim kurumlarının egemen sınıfın çıkarlarına hizmet etme ve toplumsal eşitsizlikleri yeniden üretme biçimlerini anlamak için kapsamlı bir çerçeve sunmaktadır. Marksistler, eğitimin ekonomik, kültürel ve ideolojik boyutlarını analiz ederek, kapitalist hegemonyanın sürdürüldüğü mekanizmaları aydınlatmaya ve sosyal adaleti, eşitliği ve özgürleşmeyi teşvik eden alternatifler öngörmeye çalışırlar. Eğitim sistemleri değişen sosyal, ekonomik ve siyasi manzaralara yanıt olarak evrilmeye devam ederken, Marksist teorinin sunduğu içgörüler, eğitim uygulamalarını ve yapılarını eleştirel bir şekilde sorgulamak ve dönüştürmek için elzem olmaya devam etmektedir.

Politeknik Eğitim: Kökenleri ve Evrimi

Politeknik eğitim, kökenleri Sanayi Devrimi'ne kadar uzanan, yükseköğretim alanında dönüştürücü bir güç olarak karşımıza çıkmaktadır. Hızla sanayileşen 18. ve 19. yüzyıl toplumlarında vasıflı işçilere duyulan acil ihtiyaca bir yanıt olarak ortaya çıkan politeknik kurumlar, pratik becerilere ve mesleki eğitime verdikleri önemle kısa sürede önem kazanmıştır. Eğitimin doğrudan sanayi ve toplumun ihtiyaçlarını karşılaması gerektiği inancına dayanan politeknik eğitim, mühendislik, imalat ve tarım gibi alanlarda uzmanlık eğitimi sunarak kritik bir boşluğu doldurmuştur (Small, 1984). Bu anlamda, politeknik eğitimi ortaya çıkmasına neden olan toplumsal bağlamın altını çizmek önemlidir. Sanayi Devrimi, ekonomik yapılarda radikal dönüşümlere yol açmış ve ortaya çıkan endüstrilerin taleplerini karşılamak için yeni eğitim biçimlerini gerekli kılmıştır. Politeknik kurumları bu sosyal değişimlere yenilikçi bir yanıt olarak ortaya çıkmış ve bireylerin giderek sanayileşen dünyada başarılı olmak için gereken teknik becerileri edinmeleri için bir yol sağlamıştır (Sousa & Paiava, 2022).

Politeknik eğitimin gelişimi, teknolojik ilerlemeler ve sosyal değişimlerle yakından bağlantılı olmuştur. Sektörler genişledikçe ve çeşitlendikçe, politeknik kurumları da müfredatlarını daha geniş bir disiplinler ve sektörler yelpazesini kapsayacak şekilde uyarlamışlardır. Günümüzde politeknik eğitim, bilgi teknolojisi, sağlık hizmetleri ve çevre bilimleri gibi alanlarda programlar sunarak orijinal odağının çok ötesine uzanmaktadır. Bu uyarlanabilirlik, politeknik eğitimin ayırt edici özelliği olmuş ve sürekli değişen dünyada geçerliliğini sürdürmesini sağlamıştır (Youssef & Hunter, 2010).

Bunu akılda tutarak, politeknik kurumlarının ortaya çıkan trendleri ve sektörleri öngörme ve bunlara yanıt verme çabalarını sürdürdüklerini belirtmek önemlidir. Yenilikçilik ve esneklik kültürünü teşvik eden politeknik eğitim, işgücünün değişen ihtiyaçlarını karşılamada ön planda olmaya devam etmektedir. Politeknikler, disiplinler arası iş birlikleri ve endüstri liderleriyle stratejik ortaklıklar yoluyla eğitim ve işgücü gelişiminin geleceğini şekillendirmeye devam etmektedir.



Politeknik eğitimin misyonunun merkezinde, ekonomik kalkınma ve yeniliğin teşvik edilmesindeki rolü yer almaktadır. Uygulamalı öğrenme deneyimleri sağlayarak ve uygulamalı araştırmaları teşvik ederek politeknikler ekonomik büyüme ve rekabet gücü için katalizör görevi görürler. Ayrıca, politeknik eğitim, akademi ve işverenler arasındaki yakın iş birliğinin müfredat gelişimini şekillendirmesi ve mezunların işgücü piyasası tarafından talep edilen becerilere sahip olmasını sağlamasıyla sanayinin ihtiyaçlarıyla derinlemesine bütünleşmiştir. Bu bağlamda, politeknik eğitimin yerel, bölgesel ve ulusal ekonomiler üzerindeki çok yönlü etkisini kabul etmek çok önemlidir. Politeknikler, bireyleri teknik becerilerle donatmanın ötesinde, inovasyon ekosistemlerine, girişimciliğin geliştirilmesine ve yatırımların çekilmesine katkıda bulunur. Nitelikli işgücü yetiştirerek ve inovasyon kültürünü teşvik ederek, politeknik eğitim ekonomik refahın ve sosyal ilerlemenin sağlanmasında merkezi bir rol oynamaktadır (Horn & Horn, 1982).

Küreselleşme, politeknik eğitimin uluslararasılaşmasını daha da hızlandırmış, kurumlar sınır ötesi ortaklıklar ve iş birlikleri kurmuştur. Bu küresel bakış açısı eğitim deneyimini zenginleştirmekte ve öğrencileri farklı kültürel ve mesleki bağlamlarda çalışmaya hazırlamaktadır. Ayrıca, politeknik kurumları yaşam boyu öğrenme ve sürekli eğitimi benimseyerek profesyonellerin becerilerini geliştirmeleri ve kariyerleri boyunca teknolojik gelişmeleri takip etmeleri için fırsatlar sunmaktadır (Burkle, 2011).

Buna ek olarak, politeknik eğitimin küresel vatandaşlık ve kültürlerarası anlayışın geliştirilmesindeki rolünü kabul etmek de önemlidir. Uluslararası değişim programları, iş birliğine dayalı araştırma projeleri ve çok kültürlü öğrenme ortamları aracılığıyla politeknik kurumları, öğrencileri birbirine bağlı bir dünyanın karmaşıklıklarıyla başa çıkmaya hazırlar. Politeknik eğitim, kültürel çeşitliliği ve kültürlerarası diyaloğu teşvik ederek daha kapsayıcı ve hoşgörülü toplumlar oluşturulmasına katkıda bulunur.

Bununla birlikte, politeknik eğitim de giderek karmaşıklaşan ve rekabetçi bir ortamda zorluklarla karşı karşıyadır. Finansman kısıtlamaları, demografik değişimler ve sürekli yenilik ihtiyacı, dünya çapındaki politeknik kurumlar için önemli engeller teşkil etmektedir. Ancak bu zorluklara rağmen, politeknik eğitimin geleceği umut vericidir. Dijital öğrenme, sürdürülebilirlik eğitimi ve disiplinler arası iş birliği alanlarındaki yenilikler büyüme ve gelişme için yeni yollar sunmaktadır (Horn & Horn, 1982).

Son olarak, politeknik eğitimin bu zorlukların üstesinden gelme konusundaki direncinin ve uyarlanabilirliğinin altını çizmek önemlidir. Yenilikçiliği benimseyerek, stratejik ortaklıkları teşvik ederek ve mükemmelliğe olan sarsılmaz bağlılığını sürdürerek politeknik kurumlar sürekli değişen eğitim ortamında gelişmeye devam etmektedir. Politeknik eğitim, 21. yüzyılın karmaşıklığı içinde yol alırken, bireyleri küresel bilgi ekonomisinde başarıya hazırlama misyonuna sadık kalmaktadır.

Politeknik Eğitimin İdeolojik İşlevleri

Politeknik eğitim, bireylerin topluma, ekonomiye ve yönetime yönelik algılarını, değerlerini ve tutumlarını şekillendiren karmaşık bir ideolojik işlevler ağı içinde faaliyet göstermektedir. Özünde, politeknik eğitim yalnızca teknik beceriler kazandırmakla değil, aynı zamanda bireyleri mevcut güç yapılarını ve egemen ideolojileri pekiştiren belirli ideolojik çerçeveler içinde sosyalleştirmekle de ilgilidir (Özek, 2019). Bu ideolojiler genellikle eşitsizlikleri meşrulaştırmaya ve sürdürmeye, sosyal hiyerarşileri korumaya ve statükoyu korumaya hizmet etmektedir.



Politeknik eğitimin, ideolojilerin ekonomik çıkarlar, kültürel normlar ve güç dinamikleri ile kesiştiği daha geniş sosyo-politik bağlamlara derinlemesine gömülü olduğunu kabul etmek çok önemlidir. Bilgi üretim ve yayma alanları olarak politeknik kurumlar, toplumun ideolojik manzarasını şekillendirmede önemli bir rol oynamakta, bireylerin kendilerini, başkalarını ve çevrelerindeki dünyayı nasıl algıladıklarını etkilemektedir (Small, 2005).

Politeknik eğitimin önemli ideolojik işlevlerinden biri de toplumsal hiyerarşilerin yeniden üretilmesindeki rolüdür. Politeknik kurumlar, mevcut güç yapılarını meşrulaştırarak ve egemen ideolojileri pekiştirerek sınıf, ırk, toplumsal cinsiyet ve diğer sosyal kategorilere dayalı eşitsizliklerin sürdürülmesine katkıda bulunur. Müfredat tasarımı, pedagojik uygulamalar ve kurumsal normlar aracılığıyla, politeknik eğitim statükoyu koruyan değer ve inançları aktarmakta, böylece toplumsal hiyerarşileri yeniden üretmekte ve mevcut güç farklılıklarını pekiştirmektedir (Kesik ve Bayram, 2015).

Buna dayanarak, politeknik eğitimin sosyal hiyerarşilere hem meydan okuyabileceği hem de bu hiyerarşileri sürdürebileceği yolları tanımak önemlidir. Politeknik kurumlarındaki bazı girişimler eşitsizliği ele almayı ve sosyal adaleti teşvik etmeyi amaçlarken, diğerleri müfredat içeriği, değerlendirme uygulamaları veya kurumsal politikalar yoluyla mevcut güç dinamiklerini istemeden de olsa pekiştirebilir. Bu karmaşıklıkları anlamak, politeknik eğitimin toplum üzerindeki ideolojik etkisini eleştirel bir şekilde değerlendirmek için elzemdir (Akın ve Arslan, 2014).

Dahası, politeknik eğitim, eleştirel düşünme ve sosyal eleştiri yerine teknik uzmanlık ve verimliliğe öncelik veren teknokratik bir ideoloji aktarmaktadır. Politeknik kurumları, endüstri ile ilgili becerileri vurgulayarak ve teknolojiye depolitize bir bakış açısını teşvik ederek, teknokratik yönetişim ve kontrol sistemlerinin sürdürülmesine katkıda bulunur. Teknik uzmanlığa yapılan bu vurgu genellikle daha geniş sosyal, siyasi ve etik mülahazaların üzerini örtmekte ve dar bir ilerleme ve kalkınma anlayışını pekiştirmektedir (Aytaç, 1981, s. 116).

Bunu genişletmek için, teknokratik ideolojinin demokratik katılım ve sosyal değişim üzerindeki etkilerini göz önünde bulundurmak gerekir. Teknik beceriler kuşkusuz değerli olmakla birlikte, teknokratik uzmanlığa aşırı vurgu yapılması, statükoya meydan okuyan veya alternatif bilgi ve uzmanlık biçimlerini savunan sesleri marjinalleştirebilir. Politeknik eğitimi, bilinçli vatandaşlığı ve anlamlı toplumsal dönüşümü teşvik etmek için teknik yeterlilik ile daha geniş toplumsal meselelere eleştirel katılım arasında bir denge kurmalıdır (Constable, 2009).

Dahası, politeknik eğitim, başarıyı sistemik ayrıcalık veya sömürüden ziyade bireysel liyakat ve çabanın sonucu olarak çerçeveleyerek ekonomik eşitsizliğin meşrulaştırılmasında önemli bir rol oynamaktadır. Politeknik kurumları, meritokrasi ve yukarı doğru hareketlilik söylemleri aracılığıyla, eşitsizliği sürdüren yapısal engelleri gizlemekte ve kapitalist toplumlarda eşit bir oyun alanı mitini güçlendirmektedir. Bu ideolojik işlev, mevcut ekonomik yapıları meşrulaştırmaya ve dikkatleri sistemik adaletsizliklerden uzaklaştırmaya hizmet eder.

Bununla birlikte, politeknik eğitimin meritokrasi ve bireyciliğe ilişkin baskın söylemlere de meydan okuyabileceğini kabul etmek önemlidir. Politeknik kurumlarında eşitlik, çeşitlilik ve kapsayıcılığı teşvik etmeyi amaçlayan girişimler, geleneksel başarı kavramlarını bozabilir ve marjinal grupların karşılaştığı sistemik engelleri vurgulayabilir. Politeknik eğitim, yapısal eşitsizlik konusunda eleştirel farkındalığı teşvik ederek, bireyleri ve toplulukları sosyal değişim için kolektif eylem yönünde harekete geçirme potansiyeline sahiptir (Özek, 2019).

Michael Apple'ın (2012) çalışmalarında sıklıkla vurguladığı gibi, politeknik eğitim kapitalist ideolojinin yeniden üretiminde önemli bir rol oynamaktadır.



Apple, "Politeknik eğitimin kapitalist toplumsal ilişkilerin doğallaştırılmasına ve meşrulaştırılmasına katkıda bulunarak egemen sınıfın çıkarlarının sorgusuz sualsiz kabul edilmesine yol açtığını" belirtmektedir. Bu sözler, Apple'ın politeknik eğitimin yalnızca teknik becerilerin değil, aynı zamanda kapitalist ideolojinin de aktarılmasında etkili bir araç olduğu görüşünü vurgulamaktadır. Politeknik eğitim, bireyleri kapitalist değer ve normlara göre sosyalleştirerek kapitalist ekonomideki rollere hazırlar. Politeknik kurumları, gizli müfredat ve disiplin mekanizmaları aracılığıyla rekabeti, bireyciliği ve otoriteye itaati teşvik ederek öğrencileri kapitalist üretim ilişkilerinin gereklilikleriyle uyumlu hale getirir.

Kimliklerin ve öznelliklerin kapitalist normlar doğrultusunda şekillendirilmesinde politeknik eğitimin rolünü unutmamak önemlidir. Politeknik kurumlar, belirli değer ve davranışları teşvik ederken diğerlerini marjinalleştirerek, egemen güç yapılarını pekiştiren sosyal kimliklerin inşasına katkıda bulunur. Bu süreçler hakkında eleştirel düşünmek, politeknik eğitimin daha geniş sosyo-ekonomik bağlamlar içinde bireylerin deneyimlerini ve bakış açılarını nasıl şekillendirdiğini anlamak için elzemdir (Özek, 2019).

Bu ideolojik işlevlere rağmen, politeknik eğitim aynı zamanda direniş ve dönüşüm için de fırsatlar sunmaktadır. Politeknik kurumlardaki eleştirel pedagoji, sosyal adalet girişimleri ve öğrenci aktivizmi egemen ideolojilere meydan okumakta ve alternatif eğitim vizyonlarını savunmaktadır. Politeknik eğitim, eleştirel bilinci teşvik ederek ve marjinalleştirilmiş sesleri güçlendirerek toplumsal eleştiri ve dönüştürücü praksis için bir alan haline gelebilir (Akkaya, 2014). Bu şekilde, politeknik kurumlar, egemen ideolojilere meydan okuyan ve sosyal adalet ve özgürleşme için çalışan daha eşitlikçi ve özgürlükçü eğitim biçimlerinin yaratılmasına katkıda bulunma potansiyeline sahiptir.

Politeknik Eğitimde Sınıf Mücadelesi

Genellikle sosyal hareketliliğe ve uzmanlaşmış becerilere açılan bir kapı olarak övülen politeknik eğitim, işleyişini şekillendiren köklü sınıf gerilimlerini maskelemektedir. Kapsayıcılık iddialarına rağmen, politeknik kurumlar daha geniş toplumsal eşitsizlikleri yansıtmakta ve sınıf mücadelelerinin keskin bir şekilde belirginleştiği arenalar haline gelmektedir. Özünde bu çatışma, yüksek kaliteli eğitime erişimin sosyo-ekonomik bölünmeler arasında eşit olmayan bir şekilde dağılmasından, avantaj ve dezavantaj döngülerini sağlamlaştırmasından kaynaklanmaktadır. Bu anlamda, politeknik eğitimdeki eşitsizliklerin rastgele olaylar olmadığını, kurumsal dokuya derinlemesine gömülü olduğunu kabul etmek çok önemlidir. Meritokrasi ve eşit erişim iddialarına rağmen, birçok öğrenci için gerçek, kişinin sosyal ve ekonomik geçmişinin eğitim yörüngeleri üzerinde derin bir etkiye sahip olduğudur (İnal, 2006). Ortaya çıkan bu tablo, politeknik kurumlardaki sınıfsal eşitsizliklerin sistemik doğasının altını çizmekte ve yerleşik eşitsizlikleri gidermek ve tüm öğrenciler için gerçek bir fırsat eşitliği sağlamak için yapısal reformlara duyulan ihtiyacı vurgulamaktadır.

Politeknik eğitimdeki sınıf mücadelesi en çok erişim ve eşitlik alanında görünür olmaktadır. Varlıklı kesimlerden gelen öğrenciler, özel dersler, müfredat dışı etkinlikler ve üniversiteye hazırlık kursları gibi kaynaklara daha fazla erişim sağlayarak kabul süreçlerinde genellikle rekabet avantajı elde etmektedir. Bu arada, marjinalleştirilmiş topluluklardan gelen öğrenciler, yetersiz finanse edilen okullar, mentorluk eksikliği ve eğitim destek hizmetlerine sınırlı erişim gibi sistemik engellerle karşılaşarak mevcut eşitsizlikleri daha da kötüleştirmekte ve eğitim kazanımlarını engellemektedir. Sınıfın ırk, toplumsal cinsiyet ve engellilik gibi diğer baskı biçimleriyle kesiştiğinin ve marjinalleştirilmiş öğrencilerin karşılaştığı engelleri daha da kötüleştirdiğinin altını çizmek önemlidir.



Örneğin, düşük gelirli ailelerden gelen ve aynı zamanda marjinalleştirilmiş ırksal veya etnik gruplara üye olan öğrenciler, politeknik kurumlardaki eğitim fırsatlarına erişimlerini daha da sınırlayan birleşik ayrımcılık ve marjinalleşme yaşayabilir (Terhamba & Envoh, 2018).

Dahası, politeknik kurumlardaki müfredat ve pedagoji, sınıfsal bölünmeleri yansıtmakta ve sürdürmektedir. Öğretilen içerik genellikle işgücü piyasasında değerli görülen teknik becerilere öncelik vermekte, statükoya meydan okuyan eleştirel perspektifleri ihmal etmektedir. Bu dar odak sadece mevcut güç yapılarını pekiştirmekle kalmaz, aynı zamanda alternatif bilgi biçimlerini ve bilme yollarını marjinalleştirerek baskın sosyo-ekonomik grupların çıkarlarına öncelik veren hegemonik bir anlatıyı da sürdürür. Bu anlamda, politeknik eğitimde sınıfsal eşitsizliklerin yeniden üretimini bozmak için eleştirel pedagojinin ve kültürel olarak ilgili öğretim uygulamalarının potansiyelini kabul etmek önemlidir. Eğitimciler, marjinalleştirilmiş toplulukların deneyimlerini ve bakış açılarını merkeze alarak egemen anlatılara meydan okuyabilir ve öğrencileri sınıf, güç ve ayrıcalık konularıyla eleştirel bir şekilde ilgilenmeleri için güçlendirebilir.

Politeknik kurumlarındaki çalışma ilişkileri de sınıf mücadelesinin dinamiklerini yansıtmaktadır. Genellikle güvencesiz ve düşük ücretli olan yardımcı öğretim üyeleri, sömürü ve sınırlı iş güvencesiyle karşı karşıya olan öğretim işgücünün önemli bir bölümünü oluşturmaktadır. Bu arada, ağırlıklı olarak ayrıcalıklı geçmişlerden gelen yöneticiler ve idareciler, orantısız güç ve etkiye sahip olup, kurum içinde kaynakların ve karar alma gücünün eşitsiz dağılımını sürdürmektedir (Dale, 2017). Bu nedenle, yardımcı öğretim üyelerinin politeknik eğitimde oynadıkları temel rolü kabul etmek ve adil muamele görmeleri ve kurumsal yönetişim yapılarına dahil edilmeleri için savunuculuk yapmak çok önemlidir. Yardımcı öğretim üyelerinin uzmanlıklarının ve katkılarını değer verildiği ve saygı duyulduğu daha işbirlikçi ve eşitlikçi bir akademik ortamı teşvik edebilir.

İdeolojik olarak, politeknik eğitim kapitalist değerleri ve normları destekleme ve pekiştirme eğiliminde olup sınıfsal bölünmeleri daha da derinleştirmektedir. Teknik becerilere ve piyasa odaklı eğitime yapılan vurgu, kapitalist elitlerin çıkarlarıyla uyumludur ve bilgi edinmenin metalaştırıldığı ve ekonomik kazanç için araçsallaştırıldığı bir sistemi sürdürür. Bu ideolojik hegemonya, mevcut güç yapılarını doğallaştırmaya ve meşrulaştırmaya hizmet ederek statükoya meydan okumayı zorlaştırmaktadır. Bu anlamda, politeknik eğitimin ideolojik temellerini yıkmak ve sosyal adalet ve eşitliğe dayalı alternatif modeller öngörmek için eleştirel teori ve Marksist analizin potansiyelini kabul etmek önemlidir (Terhamba & Envoh, 2018). Eğitim uygulamalarında yerleşik olan varsayım ve değerleri sorgulayarak, kapitalist hegemonyaya meydan okuyan ve marjinalleştirilmiş toplulukların ihtiyaç ve isteklerine öncelik veren daha özgürleştirici ve özgürleştirici bir eğitim sistemi yaratmak için çalışmaya ihtiyaç vardır.

Ancak, bu zorluklara rağmen, politeknik eğitimde direniş ve sosyal seferberlik için fırsatlar olduğunu unutmamak önemlidir. Öğrenci liderliğindeki hareketler, fakülte aktivizmi ve toplum örgütlenmesi çabaları, eğitim kurumlarında daha fazla eşitlik, çeşitlilik ve kapsayıcılığı savunarak baskıcı politika ve uygulamalara tarihsel olarak meydan okumuştur. Marjinalleştirilmiş sesleri yükselterek ve sistemik değişim talep ederek, bu hareketler hegemonik anlatıyı bozar ve dönüştürücü eylem için baskın ajanlardır. Bu bağlamda, öğrenciler, öğretim üyeleri, personel ve toplum üyeleri de dahil olmak üzere politeknik eğitimdeki çeşitli paydaşlar arasında dayanışma ve koalisyon oluşturmanın önemini kabul etmek çok önemlidir.



İttifaklar kurarak ve kolektif eylemi harekete geçirerek, politeknik kurumlarda ve ötesinde anlamlı bir değişim yaratmak için güç oluşturabilir ve kaynaklardan yararlanabiliriz (Klarin, 1970).

Politeknik Eğitimde Toplumsal Cinsiyet, Irk ve Kesişimsellik

Toplumsal cinsiyet, ırk ve kesişimsellik, politeknik eğitimdeki deneyimlerin şekillenmesinde önemli bir rol oynamaktadır. Bu kesişen kimlikler, eğitim kurumları içinde karmaşık dinamikler yaratarak öğrenciler için erişimi, fırsatları ve sonuçları etkilemektedir (Tefara vd., 2018). Kimberlé Crenshaw tarafından geliştirilen bir çerçeve olan kesişimsellik, sosyal kimliklerin birbirine bağlı doğasını ve çoklu baskı eksenlerinin benzersiz ayrımcılık ve ayrıcalık biçimleri üretmek için kesiştiği yolları vurgulamaktadır. Buna göre, toplumsal cinsiyet, ırk ve diğer kimliklerin kesişim noktalarının izole faktörler olmadığını, aksine bireylerin politeknik kurumlardaki deneyimlerini şekillendirmek için karmaşık yollarla etkileşime girdiğini kabul etmek önemlidir. Bu kesişim noktalarını anlamak, eğitim ortamlarında faaliyet gösteren birbirine bağlı güç ve ayrıcalık sistemlerini dikkate alan incelikli bir analiz gerektirir (Harris & Watson-Vandiver, 2020).

Politeknik eğitimde, toplumsal cinsiyet eşitliği alanındaki ilerlemelere rağmen toplumsal cinsiyet eşitsizlikleri devam etmektedir. Özellikle mühendislik ve bilgisayar bilimleri gibi erkek egemen alanlarda kadınlar, süregelen basmakalıp yargılar ve önyargılar nedeniyle erişim ve ilerleme engelleriyle karşılaşmaktadır. Ayrıca, akademik ve mesleki başarılarını engelleyen düşmanca ortamlar yaratan ayrımcılık ve tacizle de karşılaşabilirler (Tao, 2018). Bu doğrultuda, kadınların politeknik eğitimdeki deneyimlerinin çeşitliliğini ve ırk, etnik köken, cinsellik ve engellilik gibi kesişen kimliklerin eğitim yolculuklarını şekillendirme yollarını kabul etmek çok önemlidir. Ötekileştirilmiş topluluklardan gelen kadınların tanınması ve ele alınması, toplumsal cinsiyet eşitliğinin teşvik edilmesi ve kapsayıcı öğrenme ortamlarının yaratılması için elzemdir (Rankin vd., 2021).

Benzer şekilde, ırk ve etnik köken de politeknik kurumlardaki deneyimleri önemli ölçüde şekillendirmektedir. Irksal ve etnik azınlık kökenli öğrenciler genellikle ırk ayrımcılığı, klişe tehdidi ve kültürel temsil eksikliği gibi sistemik engellerle karşılaşmaktadır. Bu faktörler, politeknik kurumlarında akademik başarı, okulda kalma oranları ve kaynaklara ve fırsatlara erişimde eşitsizliklere katkıda bulunmaktadır (Shinozaki, 2017). Bu anlamda, ırksal ve etnik azınlık kökenli öğrencilerin farklı deneyimlerini ve kimliklerinin sınıf ve cinsiyet gibi diğer sosyal faktörlerle kesişme yollarını kabul etmek önemlidir. Kapsayıcı ve eşitlikçi öğrenme ortamları yaratmak, yalnızca ırkçılık ve ayrımcılığın açık biçimlerini değil, aynı zamanda eğitim çıktılarındaki eşitsizlikleri sürdüren yapısal eşitsizlikleri de ele almayı gerektirir.

Toplumsal cinsiyet ve ırkın kesişmesi, marjinalleştirilmiş öğrencilerin deneyimlerini daha da karmaşık hale getirmektedir. Örneğin beyaz olmayan kadınlar, cinsiyete ve ırka dayalı ayrımcılığın birleşik etkileri arasında gezinirken beyaz kadınlardan veya beyaz olmayan erkeklerden farklı benzersiz zorluklarla karşılaşabilir (Veenstra, 2013).

Eğitimde Politeknik Direnç

Politeknik eğitimde direniş, baskıcı yapıları sorgulayan ve olumlu bir değişim yaratmayı amaçlayan çeşitli aktivizm, savunuculuk ve muhalefet biçimlerini kapsamaktadır (McLaren, 1998, s. 451).



Öğrenciler, öğretim üyeleri, personel ve toplum üyeleri, ücret artışları, kampüs politikaları ve müfredat değişiklikleri gibi eşitsizliği sürdüren konuları ele almak için direniş çabalarına katılırlar. Öğrencilerin öncülük ettiği hareketler, protestolar ve gösteriler, şikayetlerin dile getirilmesi, farkındalığın artırılması ve kurumların anlamlı reformlar yapmasını sağlamak için güçlü araçlar olarak hizmet eder (Giroux, 2001). Bu doğrultuda, politeknik eğitimde direniş hareketleri tarafından kullanılan çeşitli strateji ve taktikleri tanımak önemlidir. Direniş, doğrudan eylem ve sivil itaatsizlikten taban örgütlenmesi ve politika savunuculuğuna kadar birçok biçim alır ve farklı toplulukların karşılaştığı belirli bağlamlara ve zorluklara uyum sağlar (Giroux, 2003). Direniş hareketleri, çeşitli taktikler benimseyerek geniş tabanlı koalisyonlar kurabilir ve baskıcı yapılara meydan okuma ve sosyal adaleti ilerletme konusundaki etkilerini en üst düzeye çıkarabilir.

Fakülte ve personel de politeknik eğitimdeki direniş çabalarında çok önemli roller oynamaktadır. Eğitimciler öğretim, araştırma ve savunuculuk yoluyla egemen anlatılara meydan okur, eleştirel düşünmeyi teşvik eder ve öğrencileri baskıcı sistemleri sorgulamaları ve bunlara meydan okumaları için güçlendirir. Müfredat reformu, çeşitlilik atölyeleri ve kapsayıcı pedagoji eğitimi gibi fakülte öncülüğündeki girişimler, daha eşitlikçi ve kapsayıcı öğrenme ortamlarının yaratılmasına katkıda bulunur (Honyenuga, 2013).

Politeknik eğitimde direniş çabalarının ilerletilmesinde öğretim üyeleri ve personel arasında dayanışma ve kolektif eylemin rolünü kabul etmek çok önemlidir. Eğitimciler, bölümler, disiplinler ve idari birimler arasında ittifaklar kurarak seslerini yükseltebilir ve kurumsal değişim ve dönüştürücü eylem için kolektif güçlerini kullanabilirler. Öğretim üyeleri ve personel, iş birliğine dayalı çabalar yoluyla, direniş hareketlerini güçlendiren ve politeknik kurumlarda dayanışma kültürünü teşvik eden eleştirel diyalog, karşılıklı destek ve ortak öğrenme alanları yaratabilir.

Topluluk katılımı ve ortaklıklar, politeknik eğitimde direniş ve alternatif çabaların ayrılmaz bir parçasıdır. Politeknik kurumları, yerel topluluklar, taban örgütleri ve savunuculuk gruplarıyla iş birliği yaparak, direniş çabalarını güçlendirmek ve toplumun ihtiyaç ve çıkarlarına öncelik veren alternatif eğitim modellerini ilerletmek için dış kaynaklardan, uzmanlıktan ve destekten yararlanabilir. Başka bir deyişle, politeknik eğitimde direniş ve alternatif çabalar içinde topluluk ortaklıklarının karşılıklı doğasını kabul etmek önemlidir (Giroux, 2003). Politeknik kurumları topluluk kuruluşlarına kaynak ve uzmanlık sunabilirken, topluluk üyelerinin bilgi, deneyim ve bakış açılarından da faydalanırlar. Politeknikler, karşılıklı saygı ve mütekabiliyete dayalı gerçek ortaklıkları teşvik ederek, toplumsal eşitsizliklerin temel nedenlerini ele alan ve ortak adalet ve kurtuluş hedeflerini ilerleten çözümleri birlikte yaratabilirler.

Politeknik eğitimdeki direniş, kurumsal sınırların ötesine geçerek daha geniş çaplı sosyal ve sistemik değişimi de kapsamaktadır. Black Lives Matter, Me Too ve iklim adaleti aktivizmi gibi kesişimsel hareketler, kesişen baskı biçimlerine meydan okumak ve eğitim sistemlerinde ve uygulamalarında dönüştürücü değişimi savunmak için eğitimle kesişmektedir (McLaren, 2015, s. 334). Bu anlamda, politekniklerin içindeki ve ötesindeki direniş hareketlerinin birbiriyle bağlantılı olduğunu kabul etmemiz gerekir. Politeknik kurumları, daha geniş sosyal adalet hareketleriyle ittifaklar kurarak etkilerini artırabilir ve daha büyük kurtuluş ve kolektif özgürleşme mücadelelerine katkıda bulunabilir. Baskının kesişim noktalarını ve mücadelelerin birbirine bağımlılığını kabul etmek, hareketler arasında dayanışma inşa etmek ve kalıcı toplumsal değişim yaratmak için elzemdir.

Politeknik eğitimin baskın modellerine alternatifler eşitlik, adalet ve özgürleşme ilkelerine öncelik vermektedir.



Bu alternatif yaklaşımlar baskıcı yapıları bozmayı, marjinalleştirilmiş sesleri merkeze almayı ve kapsayıcı ve güçlendirici öğrenme ortamlarını teşvik etmeyi amaçlamaktadır (McLaren, 2015, s. 451). Toplum temelli eğitim girişimleri, katılımcı eylem araştırması projeleri ve iş birliğine, eleştirel sorgulamaya ve topluluk katılımına öncelik veren işbirlikçi öğrenme modelleri bunlara örnek olarak verilebilir.

Alternatif eğitim modellerinin baskıcı sistemlere meydan okuma ve onları dönüştürme potansiyelinin farkına varmak önemlidir. Politeknik eğitime alternatif yaklaşımlar, marjinalleştirilmiş toplulukların seslerini ve deneyimlerini merkeze alarak radikal hayal gücü, kolektif özgürleşme ve dönüştürücü sosyal değişim için alanlar yaratabilir. Egemen paradigmalara meydan okuyan çeşitli pedagoji ve epistemolojileri benimsemek, tüm öğrencilerin onurunu, eylemliliğini ve insanlığını onurlandıran eğitim ortamları yaratmak için gereklidir (McLaren, 2015, s. 308).

Politeknik eğitimin amacını ve işlevini eleştirel bir şekilde yeniden tasarlamak, direnişi ve alternatif çabaları ilerletmek için merkezi bir öneme sahiptir. Politeknik kurumları, geleneksel eğitim sistemlerinin temelini oluşturan kapitalist, sömürgeci ve ataerkil ideolojilere meydan okuyarak dönüştürücü öğrenme, kolektif eylem ve toplumsal değişim için alanlar geliştirebilir. Başka bir deyişle, politeknik eğitimin yeniden tasarlanması sürecinde marjinalleştirilmiş bakış açılarının ve seslerin merkeze alınmasının önemini kabul etmek gerekir (Gramsci & Buttigieg, 2002). Politeknik kurumları, baskı sistemlerinden en çok etkilenen toplulukların bilgi, deneyim ve isteklerine öncelik vererek, direniş ve alternatif çabaların eşitlik, adalet ve özgürleşme ilkelerine dayanmasını sağlayabilir. Eğitimde sömürgecilik ve baskı karşıtı bir yaklaşım benimsemek, baskıcı yapıları ortadan kaldırmak ve daha adil ve eşitlikçi bir toplumu teşvik etmek için çok önemlidir.

Politeknik Eğitim Üzerine Küresel Perspektifler

Politeknik eğitim, dünyanın farklı bölgelerinde önemli farklılıklar gösteren dinamik bir alandır. Politeknik eğitime ilişkin küresel perspektifler, yerel bağlamlar, kültürel normlar ve sosyo-ekonomik faktörler tarafından şekillendirilen çok çeşitli yaklaşımları, felsefeleri ve uygulamaları kapsamaktadır. Ulusal sınırları aşan ortak temalar ve zorluklar olsa da her ülke ve bölge masaya benzersiz bakış açıları ve öncelikler getirmektedir. Dahası, eğitimin küreselleşmesi, dünyanın dört bir yanındaki politeknik kurumlar arasında fikir alışverişinin, en iyi uygulamaların ve iş birliğinin artmasına yol açarak alanı farklı bakış açıları ve yaklaşımlarla zenginleştirmiştir (Jahun, 2017).

Avrupa'da politeknik eğitimin kökleri mesleki eğitim ve uygulamalı öğrenme geleneklerine dayanmaktadır. Almanya ve İsviçre gibi ülkeler, sınıf içi öğrenimi endüstriyel ortamlarda pratik, uygulamalı deneyimle birleştiren köklü ikili eğitim sistemlerine sahiptir. Bu sistemler, vasıflı işçiler yetiştirme ve işgücü piyasasının ihtiyaçlarını karşılama becerileriyle büyük saygı görmektedir. Ayrıca, Avrupa'daki politeknik kurumlar, hızla değişen küresel ortamda geçerliliklerini korumak için eğitimde dijitalleşme ve inovasyonu giderek daha fazla benimsemektedir (Carvalho & Diogo, 2020).

Asya'da politeknik eğitim, ekonomik kalkınmanın ve teknolojik inovasyonun desteklenmesinde kritik bir rol oynamaktadır. Singapur ve Güney Kore gibi ülkeler, bilgiye dayalı ekonomilere geçişlerini desteklemek için politekniklere büyük yatırımlar yapmıştır. Bu ülkelerdeki politeknikler genellikle en yeni araştırmaları geliştirmek ve öğrencilere gerçek dünya deneyimi sağlamak için endüstri ortaklarıyla yakın bir şekilde çalışmaktadır.



Ayrıca, çevrimiçi eğitim platformlarının ve dijital öğrenme araçlarının yükselişi, Asya politekniklerinin daha geniş bir kitleye ulaşması ve eğitime erişimi artırması için yeni fırsatlar yaratmıştır (Narayanana, 2017).

Afrika'da politeknik eğitim, genç işsizliği ve beceri eksikliği gibi kıtanın acil sosyo-ekonomik sorunlarını ele almanın bir yolu olarak görülüyor. Birçok Afrika ülkesi politeknik eğitime erişimi genişletmek ve eğitim kurumları ile işgücü piyasası arasındaki bağlantıları güçlendirmek için yatırım yapmaktadır. Ancak sınırlı kaynaklar ve altyapı, kıtanın pek çok yerinde güçlü politeknik sistemlerin geliştirilmesinin önünde önemli engeller teşkil etmektedir. Dahası, Afrika'da politeknik eğitimin şekillendirilmesinde yerel bilginin ve toplum temelli yaklaşımların önemi giderek daha fazla kabul görmektedir (Iddrisu vd., 2014).

Amerika kıtasındaki politeknik eğitim, bölgedeki eğitim sistemlerinin çeşitliliğini yansıtan geniş bir model ve yaklaşım yelpazesini kapsamaktadır. Amerika Birleşik Devletleri ve Kanada gibi ülkelerde politeknik kurumlar uygulamalı araştırma, inovasyon ve sanayi ortaklıklarına odaklanmalarıyla bilinmektedir. Bu kurumlar, bölgesel ekonomik kalkınmayı desteklemede ve öğrencileri yüksek talep gören alanlarda kariyer yapmaya hazırlamada hayati bir rol oynamaktadır. Latin Amerika ülkeleri de sosyal hareketliliği teşvik etmek ve eşitsizliği azaltmak için politekniklere giderek daha fazla yatırım yapmaktadır (Balich, 1995).

Yaklaşımların çeşitliliğine rağmen, küresel olarak politeknik eğitimin karşı karşıya olduğu ortak zorluklar vardır. Bunlar arasında finansman kısıtlamaları, kalite güvencesi, müfredatın uygunluğu, eşitlik ve erişim yer almaktadır. Bu zorlukların ele alınması, politeknik eğitimin toplumun ihtiyaçlarına duyarlı kalmasını sağlamak için politika yapıcılar, eğitimciler, endüstri liderleri ve diğer paydaşlar arasında iş birliğine dayalı çabalar gerektirmektedir. Ayrıca, COVID-19 salgını, politeknik eğitimde esneklik ve uyarlanabilirliğin önemini vurgulamış ve kurumları karma öğrenme ve çevrimiçi sunum modları gibi yenilikçi çözümler keşfetmeye sevk etmiştir.

Politeknik eğitimine ilişkin küresel perspektifleri şekillendiren önemli bir eğilim, yaşam boyu öğrenme ve sürekli beceri geliştirmeye yapılan vurgunun artmasıdır. Hızlı teknolojik değişim ve ekonomik belirsizlik çağında, politeknik kurumları programlarını ve hizmetlerini bireyleri kariyerleri boyunca destekleyecek şekilde uyarlamaktadır. Buna esnek öğrenme seçenekleri, çevrimiçi kurslar ve çalışan profesyoneller için beceri geliştirme fırsatları sunmak da dahildir. Ayrıca, bireylerin geleneksel olmayan öğrenme yollarıyla edindikleri becerileri ve yetkinlikleri tanımanın ve doğrulamanın bir yolu olarak mikro kimlik bilgileri ve dijital rozetler kavramı ilgi görmektedir.

Politekniklerin sürdürülebilir kalkınmayı teşvik etme ve iklim değişikliği, kentleşme ve sosyal eşitsizlik gibi küresel zorlukları ele alma konusundaki rolü de bir o kadar önemlidir. Politeknikler, sürdürülebilirlik ilkelerini müfredatlarına ve araştırma gündemlerine entegre ederek, öğrencileri kendi toplumlarında ve ötesinde olumlu değişimin aracıları olmaya hazırlamak için eşsiz bir fırsata sahiptir. Öğrenciler karmaşık sosyo-çevresel sorunlara bütüncül çözümler keşfetmeye teşvik edildikçe, politeknik eğitimde disiplinler arası iş birliği ve sistem düşüncesine de giderek daha fazla vurgu yapılmaktadır.

Politeknik eğitimine ilişkin küresel perspektifler, uluslararası iş birliği ve değişimin önemini de vurgulamaktadır. Politeknikler diğer ülkelerdeki kurumlarla ortaklık kurarak araştırma, yenilikçilik ve öğrenci hareketliliği kapasitelerini artırabilirler. Uluslararasılaştırma çabaları aynı zamanda kültürel alışverişi ve karşılıklı anlayışı teşvik ederek öğrencileri birbirine bağlı bir dünyada başarılı olmaya hazırlar. Ayrıca, küresel vatandaşlık eğitimi, öğrencilerin küresel sorunlara ilişkin farkındalıklarını ve küresel ölçekte olumlu değişime katkıda bulunma sorumluluklarını geliştirmenin bir yolu olarak önem kazanmaktadır (Chinda, 2021).



Sonuç olarak, politeknik eğitime ilişkin küresel perspektifler, ülkelerin ve bölgelerin mesleki ve uygulamalı öğrenmeye yaklaşımlarındaki çeşitliliği yansıtmaktadır. Alanı şekillendiren ortak zorluklar ve eğilimler olsa da her bağlam masaya benzersiz fırsatlar ve öncelikler getirmektedir. En iyi uygulamaları paylaşarak, iş birliğini teşvik ederek ve yenilikçiliği benimseyerek politeknikler, bireyleri 21. yüzyıl ekonomisinde başarıya hazırlamada hayati bir rol oynamaya devam edebilir. Ayrıca, paydaşlar arasında sürekli diyalog ve fikir alışverişi, sürekli gelişimi teşvik etmek ve politeknik eğitimin hızla değişen bir dünyanın ihtiyaçlarına uygun ve duyarlı kalmasını sağlamak için gereklidir.

Politeknik Eğitimin Gerçekleştirilmesi için Zorluklar ve Fırsatlar

Uygulamalı öğrenmeye ve gerçek dünya becerilerinin geliştirilmesine verdiği önemle politeknik eğitim, eğitimde ve genel olarak toplumda dönüştürücü bir değişim yaratma konusunda muazzam bir potansiyele sahiptir. Bununla birlikte, tam dönüştürücü potansiyelini ortaya çıkarmak için ele alınması gereken önemli zorluklarla da karşı karşı yadır.

Dönüştürücü değişim için politeknik eğitimden yararlanmanın önündeki en önemli zorluklardan biri, geleneksel eğitim paradigmaları ve kurumsal yapılar içindeki dirençtir. Politeknik kurumları genellikle pratik beceriler yerine akademik titizliğe ve gerçek dünya uygulamaları yerine teorik bilgiye öncelik veren daha geniş eğitim sistemleri içinde faaliyet göstermektedir. Bu direncin üstesinden gelmek, eğitimin doğası ve amacı hakkındaki yerleşik inançlara meydan okumayı ve farklı bilgi ve uzmanlık biçimlerine değer veren daha bütüncül ve kapsayıcı bir yaklaşımı savunmayı gerektirir (Darkey & Oduro, 2012).

Karmaşıklığın üstesinden gelmek, politeknik eğitimi dönüştürmenin doğasında olan bir başka zorluktur. Politeknik kurumları akademi, endüstri ve toplumun kesiştiği noktada faaliyet göstermekte ve karmaşık bir ilişkiler, çıkarlar ve beklentiler ağında gezinmelerini gerektirmektedir. Öğrenciler, öğretim üyeleri, işverenler ve topluluklar dahil olmak üzere çeşitli paydaşların ihtiyaç ve önceliklerini anlamak, eleştirel düşünme, yaratıcılık ve sosyal sorumluluğu teşvik ederken 21. yüzyıl işgücünün taleplerini karşılayan dönüştürücü eğitim programları tasarlamak için gereklidir (Aslan ve Topçu, 2010).

Politeknik eğitime yönelik kapsayıcı bir yaklaşım, dönüştürücü değişimin geçmişleri veya koşulları ne olursa olsun tüm öğrencilere fayda sağlamasını temin etmek açısından kritik önem taşımaktadır. Bu da sosyoekonomik durum, ırk, cinsiyet ve engellilik gibi erişim ve başarının önündeki sistemik eşitsizliklerin ve engellerin ele alınmasını gerektirir. Politeknik kurumları, çeşitliliği, eşitliği ve kapsayıcılığı aktif bir şekilde teşvik ederek, yeterince temsil edilmeyen gruplardan öğrencileri güçlendiren ve onları hızla değişen dünyada başarılı olmaya hazırlayan öğrenme ortamları yaratabilir (Demir ve Akça, 2021).

Politeknik eğitimde dönüştürücü değişimi ilerletmek için teknoloji ve inovasyonu benimsemek şarttır. Çevrimiçi öğrenme platformları, sanal gerçeklik simülasyonları ve yapay zeka gibi dijital teknolojiler, eğitime erişimi genişletmek, öğrenme deneyimlerini kişiselleştirmek ve teori ile pratik arasındaki boşluğu doldurmak için yeni fırsatlar sunmaktadır. Bununla birlikte, teknolojinin potansiyelinden yararlanmak, gizlilik, eşitlik ve dijital uçurum konuları da dahil olmak üzere etik sonuçlarının dikkatle değerlendirilmesini gerektirir.

Politeknik kurumlarının, dönüştürücü değişimin doğasında var olan belirsizlikler ve aksaklıklarla başa çıkabilmek için esneklik ve uyum yeteneği geliştirmeleri çok önemlidir. Bu, bir deney, sürekli iyileştirme ve başarısızlıktan öğrenme kültürünü teşvik etmeyi içerir (Uçkaç, 2019).



Politeknikler, değişimi büyüme ve inovasyon için bir fırsat olarak benimseyerek kendilerini eğitimde ve toplumda dönüştürücü değişimin dinamik ve duyarlı aktörleri olarak konumlandırabilir.

İş birliği ve ortaklık, politeknik eğitimde dönüştürücü değişimi ilerletmek için kilit stratejilerdir. Politeknikler, endüstri, hükümet, kâr amacı gütmeyen kuruluşlar ve diğer eğitim kurumlarıyla güçlü ortaklıklar kurarak, karmaşık zorlukları ele almak ve yeni firsatları yakalamak için kolektif kaynaklarını, uzmanlıklarını ve etkilerini kullanabilirler. İş birliği aynı zamanda politekniklerin yeni trendleri ve en iyi uygulamaları takip etmelerini sağlayarak eğitim programlarının hızla gelişen bir ortamda ilgili ve etkili kalmasını sağlar (Uçkaç, 2019). Tabandan liderlik ve toplum katılımı, politeknik eğitimde dönüştürücü değişimin güçlü itici güçleridir. Politeknik kurumları, öğrencileri, öğretim üyelerini, personeli, mezunları ve topluluk üyelerini karar alma süreçlerine ve program geliştirmeye aktif olarak dahil ederek, eğitim tekliflerinin paydaşlarının ihtiyaç ve isteklerine yanıt vermesini sağlayabilir. Tabandan gelen liderlerin güçlendirilmesi ve ortak yönetişim ve katılımcı karar alma kültürünün teşvik edilmesi, politeknik topluluğu içinde sahiplenme ve hesap verebilirlik duygusunu güçlendirerek aşağıdan yukarıya doğru olumlu değişimi teşvik eder.

Sonuç olarak, politeknik eğitim, öğrencileri karmaşık zorlukların üstesinden gelmek ve yeni fırsatları yakalamak için gereken bilgi, beceri ve zihniyetle donatarak eğitimde ve toplumda dönüştürücü bir değişim sağlama konusunda büyük bir potansiyele sahiptir. Ancak bu potansiyelin hayata geçirilmesi, değişime karşı dayanıklılık, karmaşıklığın üstesinden gelme, kapsayıcılığı teşvik etme, teknoloji ve yeniliği kucaklama, dayanıklılık ve uyum sağlama, iş birliği ve ortaklığı teşvik etme ve taban liderliğini güçlendirme gibi zorlukların üstesinden gelinmesini gerektirmektedir. Politeknikler bu zorlukları ele alarak ve fırsatları değerlendirerek eğitimin geleceğini şekillendirmede ve öğrencileri hızla değişen dünyada başarılı olmaya hazırlamada öncü bir rol oynayabilir.

Gelecekteki Yönelimler

Politeknik eğitime ilişkin Marksist perspektifler üzerine yaptığımız araştırmadan elde ettiğimiz içgörüler üzerinde düşündüğümüzde, eğitimin gelecekteki yönünün sosyal adalet, eşitlik ve özgürleşme ilkeleri tarafından yönlendirilmesi gerektiği açıkça ortaya çıkmaktadır. Tartışmamız boyunca vurgulanan zorluklar ve fırsatlar, bizi politeknik kurumlar için tüm öğrencilerin, özellikle de marjinalleştirilmiş ve yeterince temsil edilmeyen topluluklardan gelenlerin ihtiyaç ve isteklerine öncelik veren alternatif gelecekler öngörmeye zorlamaktadır (McLaren, 2015, s. 271).

Politeknik eğitimin gelecekteki yönlerinden biri, öğrenciler arasında eleştirel bilincin ve siyasi katılımın geliştirilmesinde yatmaktadır. Politeknik kurumları, Marksist ilkeleri müfredata ve pedagojik yaklaşımlara entegre ederek, öğrencileri eşitsizlik ve adaletsizliği sürdüren sosyal, ekonomik ve siyasi yapıları eleştirel bir şekilde analiz etme ve bunlara meydan okuma konusunda güçlendirebilir. Bu yaklaşım, öğrencileri toplumsal değişim çabalarına aktif olarak katılmak için gereken araç ve bilgilerle donatarak, eylemlilik ve kolektif sorumluluk duygusunu teşvik eder.

Ayrıca, politeknik eğitimin geleceği iş birliği, dayanışma ve toplum katılımına dayanmalıdır. Politeknikler, taban örgütleri, sendikalar, sosyal hareketler ve diğer eğitim kurumlarıyla güçlü ortaklıklar kurarak etkilerini artırabilir ve ortak hedefler doğrultusunda kolektif kaynaklardan yararlanabilir. Bu işbirlikçi yaklaşım sadece eğitim kurumları ile çevrelerindeki topluluklar arasındaki bağları güçlendirmekle kalmaz, aynı zamanda sistemik zorlukların ele alınmasında kolektif sahiplenme ve ortak sorumluluk duygusunu da teşvik eder.



Buna ek olarak, inovasyon ve teknolojik gelişmelerin benimsenmesi, politeknik eğitimin geleceği için umut verici yollar sunmaktadır (Cramer & Brown 1974, s. 400). Politeknik kurumları, öğrenciler için erişilebilirliği, esnekliği ve kişiselleştirilmiş öğrenme deneyimlerini artırmak için dijital teknolojilerin, çevrimiçi öğrenme platformlarının ve etkileşimli öğretim araçlarının potansiyelinden yararlanabilir. Bununla birlikte, teknolojik yeniliklere eleştirel bir gözle yaklaşmak, sosyal adalet ilkeleriyle uyumlu olmasını ve mevcut eşitsizlikleri daha da kötüleştirmemesini veya baskıcı yapıları güçlendirmemesini sağlamak önemlidir.

Ayrıca, politeknik eğitimin geleceği çeşitlilik, eşitlik ve kapsayıcılığa öncelik vermelidir. Politeknik kurumları, erişim ve başarının önündeki sistemik engelleri aktif bir şekilde ele alarak, öğretim üyeleri ve personel arasında farklı temsilleri teşvik ederek ve marjinalleştirilmiş toplulukların seslerini ve deneyimlerini merkeze alarak tüm öğrenciler için daha kapsayıcı ve sıcak öğrenme ortamları yaratabilir. Çeşitlilik ve kapsayıcılığa yönelik bu taahhüt sadece ahlaki bir zorunluluk değil, aynı zamanda eğitimde yenilik, yaratıcılık ve mükemmelliği teşvik etmek için stratejik bir zorunluluktur.

Marksist perspektiflerin 21. yüzyılda politeknik eğitimin karşı karşıya olduğu zorlukları ve firsatları anlamak için değerli içgörüler ve araçlar sunduğu açıktır. Politeknik kurumları sosyal adalet, eşitlik ve özgürleşme ilkelerini merkeze alarak herkes için daha adil, eşitlikçi ve sürdürülebilir bir geleceğe doğru ilerleyebilirler (Apple, 1984, s. 209). Modern dünyanın karmaşıklığı içinde yol alırken, eğitimin dönüştürücü potansiyelini unutmamalıyız. Öğrencileri eleştirel düşünürler, ilgili vatandaşlar ve sosyal değişim ajanları olarak güçlendiren politeknik kurumlar yaratmaya çalışmak en önemli hedeflerimizden biri olmalıdır.

Sonuç

Politeknik eğitim üzerine Marksist perspektifleri inceleyen bu çalışma, eğitim sistemlerinin ve toplumsal yapıların şekillendirilmesinde teori ve pratik arasındaki karmaşık etkileşime ışık tutmaya yardımcı olmuştur. Ayrıca, politeknik eğitimin kapitalist toplumun egemen ideolojilerini ve güç dinamiklerini yansıtma ve sürdürme biçimlerini ortaya koyarken, dönüştürücü değişim için potansiyel yollar da sunmaktadır.

Politeknik eğitime dair Marksist perspektiflerin merkezinde, eğitimin sınıfsal bölünmeleri, eşitsizlikleri ve kapitalist üretim ilişkilerini yeniden üretme ve sürdürmedeki rolüne dair eleştirel bir sorgulama yer almaktadır. Politeknik eğitimin içinde işlediği gizli müfredatı, kurumsal yapıları ve sosyo-ekonomik bağlamları inceleyerek, eğitimin mevcut iktidar yapılarını güçlendiren ve egemen ideolojileri meşrulaştıran bir toplumsal yeniden üretim alanı olarak nasıl hizmet ettiğini ortaya çıkarmaya çalıştık (Aplle, 1984, s.113).

Ancak bu çalışma aynı zamanda politeknik eğitimde direniş, dayanışma ve dönüştürücü değişim firsatlarını da aydınlatmaya çalışmıştır. Kolektif eylem, eleştirel pedagoji ve alternatif eğitim modelleri aracılığıyla, politeknik kurumlar kapitalist ideolojinin hegemonyasına meydan okuma, marjinalleştirilmiş toplulukları güçlendirme ve daha eşitlikçi ve adil bir toplumu teşvik etme potansiyeline sahiptir.

İleriye baktığımızda, politeknik eğitimde dönüştürücü değişim için mücadelenin devam ettiği ve çok yönlü olduğu açıktır. Baskıcı yapıları yıkmak, egemen anlatılara meydan okumak ve eğitimi bir özgürleşme ve toplumsal dönüşüm aracı olarak yeniden tasarlamak için sürekli bir çaba olduğunu unutmamalıyız (Giroux, 2001, s. 73).

21'inci yüzyılın karmaşıklığı içinde yol alırken, politeknik eğitime ilişkin Marksist perspektiflerden elde edilen içgörüler eğitimciler, politika yapıcılar ve aktivistler için yol gösterici bir çerçeve işlevi görebilir.



Öğrencileri yalnızca işgücü için gerekli bilgi ve becerilerle donatmakla kalmayan, aynı zamanda onları çevrelerindeki dünyayla eleştirel bir şekilde ilişki kurmaları ve onu dönüştürmeleri için güçlendiren politeknik kurumlar yaratmak üzere teori ve pratik arasında köprü kurmak için çalışmamız kritik önem taşımaktadır.

Son olarak, politeknik eğitime ilişkin Marksist perspektifler üzerinden yaptığımız yolculuk, eğitim sistemlerini şekillendiren temel varsayımların ve güç dinamiklerinin sorgulanmasının önemini vurgulamıştır. Eğitime eleştirel ve dönüştürücü bir yaklaşım benimseyerek, herkes için daha adil, eşitlikçi ve demokratik bir toplum inşa etmek için çalışabiliriz.

Ayrıca, politeknik eğitimde dönüştürücü değişim için verilen mücadelenin küresel boyutlarının farkına varmak önemlidir. Eğitim sistemleri giderek daha fazla birbirine bağlanır ve küresel güçlerden etkilenir hale geldikçe, kapitalist hegemonyaya meydan okuma ve alternatif eğitim modelleri geliştirme çabaları daha geniş bir küresel bağlama oturtulmalıdır. Sınırlar ötesi dayanışma, uluslararası ortaklarla iş birliği ve farklı deneyim ve perspektiflerden öğrenme, küresel ölçekte anlamlı bir değişimi teşvik etmek için elzemdir.

Dahası, politeknik eğitimde dönüştürücü değişimin sağlanması, eğitim çıktılarını ve deneyimlerini şekillendiren kesişen baskı sistemlerinin ele alınmasını gerektirmektedir. Kesişimsellik bize bireylerin deneyimlerinin ve kimliklerinin ırk, cinsiyet, sınıf, cinsellik ve yetenek gibi birçok kesişen faktör tarafından şekillendirildiğini hatırlatır (McLaren, 2015, s. 334). Bu nedenle, dönüştürücü değişim çabaları, marjinalleştirilmiş toplulukların karşılaştığı benzersiz zorlukları tanıyıp ele alarak ve herkes için adalet ve eşitlik için çabalayarak doğası gereği kesişimsel olmalıdır.

Politeknik eğitimde dönüştürücü değişime yönelik yolculuk özünde karmaşık, zorlu ve çok yönlüdür. Eleştirel sorgulama, kolektif eylem ve sürekli öğrenme ve adaptasyon taahhüdü gerektirir. Baskıcı sistemlerden en çok etkilenenlerin seslerini ve deneyimlerini merkeze alarak, dayanışma ve iş birliğini benimseyerek ve eşitsizliği sürdüren baskın anlatılara ve güç yapılarına meydan okuyarak, sosyal adalet, eşitlik ve özgürleşme ilkelerini gerçekten somutlaştıran politeknik kurumlar yaratmak için çalışabiliriz.

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VASORELAXANT EFFECTS OF VOLATILE AROMATIC COMPOUNDS ON AORTA

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ABSTRACT

Introduction and Purpose: Volatile aromatic compounds include several chemical classes, such as alcohols, aldehydes, and ethers. The compounds belonging to the classes have beneficial effects on human health. This review aims to provide the vasorelaxant effects of volatile aromatic compounds on the aorta.

Materials and Methods: A literature search was conducted on PubMed, Science Direct, and WoS electronic databases. We detected 10 volatile aromatic compounds that influence the contractility of aortic smooth muscle.

Results: Aromatic alcohols produced relaxant responses to various contractile agents in the aortae. Geraniol significantly abolished contractions induced by PE. Phenyethyl alcohol led to a relaxation in rat aortic strips contracted with PE. The inhibitory effect may be related to BK_{Ca} channel activation. Menthol inhibited KCl-evoked contractions in the presence and absence of endothelium. β -Citronellol induced relaxation in the aorta. Cinnamic alcohol suppressed contractions treated by PE in aorta segments with endothelium intact. L-NAME, ODQ, MB, 4-AP, and glibenclamide attenuated the vasorelaxation effect of cinnamic alcohol. Moreover, the alcohol blunted calpeptin-mediated contractions. The vasoactive effects of aromatic aldehydes were investigated on aortic preparations. 5-methyl-2-furaldehyde exerted myorelaxant properties on aortic segments contracted by PE. Vanillin did not trigger a significant change in the aorta activity. Aromatic ethers mediate the relaxation of the aorta. Eucalyptol caused inhibition of PE-stimulated aortic contraction, which was decreased by L-NAME. Methyl eugenol could hinder potassium-mediated contractions of aortic segments.

Discussion and Conclusion: Geraniol, phenyethyl alcohol, menthol, β -citronellol, and cinnamic alcohol from aromatic alcohols; 5-methyl-2-furaldehyde, vanillin, and cinnamaldehyde from aromatic aldehydes; and eucalyptol and methyl eugenol from ethers showed relaxing activities in isolated aortic rings. The volatile compounds may be vasorelaxant agents to treat cardiovascular diseases, including hypertension and atherosclerosis.

Keywords: Volatile aromatic compounds; vasorelaxation; aorta

GİRİŞ

Volatil aromatik bileşikler, düşük kaynama noktalarına sahip, uçucu özellikler gösteren ve çevresel koşullara bağlı olarak kolayca buharlaşabilen organik bileşiklerdir. Bu bileşiklerin insan sağlığı üzerindeki terapötik etkileri, özellikle sinir sistemi ve bağışıklık sistemi üzerindeki etkileri ile dikkat çekmektedir.



Volatil aromatik bileşiklerin, merkezi sinir sistemi üzerinde düzenleyici ve yatıştırıcı etkiler yaratarak psikolojik bozuklukların tedavisinde potansiyel faydalar sağladığı gösterilmiştir. Özellikle stres, anksiyete ve depresyon gibi durumların yönetilmesinde, bu bileşiklerin sinir hücreleriyle etkileşime girerek nörotransmitter seviyelerini düzenlediği ve bunun sonucunda psikolojik halini iyileştirdiği tespit edilmiştir (Lee ve Kim, 2024; Gholami vd., 2023). Ayrıca, volatil aromatik bileşiklerin antiinflamatuvar ve analjezik özellikleri, bu bileşiklerin ağrı yönetimi ve inflamasyonla ilişkili hastalıkların tedavisinde de etkili olabileceğini göstermektedir (Mieczkowski vd., 2022).

Bunun yanında, volatil aromatik bileşiklerin solunum yolu üzerinde rahatlatıcı etkiler yaratarak astım, bronşit gibi solunum yolu hastalıklarının semptomlarını hafiflettiği de bildirilmiştir (Khare ve Sharma, 2023). Volatil aromatik bileşiklerin vücutta nasıl emildiği, metabolize edildiği ve biyolojik aktivitesi üzerine yapılan araştırmalar, terapötik etkilerinin çeşitlenmesine olanak tanımaktadır.

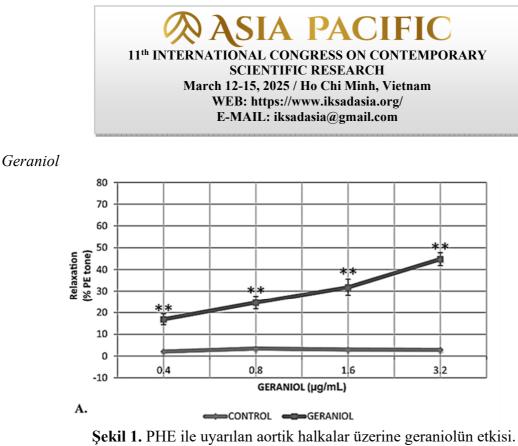
Volatil aromatik bileşiklerin kardiyovasküler sağlık üzerine etkileri, son yıllarda yapılan kapsamlı araştırmalarla daha iyi anlaşılmaktadır. Antioksidan, antiinflamatuvar ve vazodilatör özellikleri, kardiyovasküler hastalıkların tedavi ve önlenmesinde önemli bir potansiyel taşımaktadır. Volatil aromatik bileşiklerin damar sağlığını iyileştirme potansiyeli, oksidatif stresi azaltması ve iltihabı önlemesi ile ilişkilidir. Bu mekanizmalar, özellikle ateroskleroz ve hipertansiyon gibi kardiyovasküler hastalıkların seyrini olumlu yönde etkileyebilir (Bensouilah vd., 2022).

MATERYAL ve METOT

Bu çalışmada, aort düz kası üzerine vazorelaksan etkiye sahip volatil aromatik bileşiklerin belirlenmesi amacıyla kapsamlı bir literatür taraması yapılmıştır. Tarama, PubMed, Science Direct ve Web of Science (WoS) elektronik veri tabanlarında gerçekleştirilmiştir. Literatür taraması sırasında, "volatile aromatic compounds", "smooth muscle", "aorta", "contractility" ve "relaxation" anahtar kelimeleri kullanılarak, aort düz kasını gevşetebilen 10 volatil aromatik bileşik tespit edilmiştir.

BULGULAR

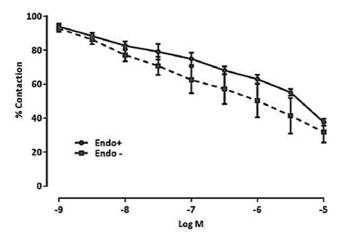
Bu çalışmada gerçekleştirilen literatür taraması sonucunda, aort düz kası üzerinde miyorelaksan aktivitiye sahip çeşitli volatil aromatik bileşikler tespit edilmiştir. Bu bileşikler, aromatik alkoller arasında geraniol, fenetil alkol, mentol, β -sitronellol ve sinnamik alkol; aromatik aldehitler arasında 5-metil-2-furaldehit, vanilin ve sinnamaldehit; ve eterler arasında ise ökaliptol ve metil öjenol olarak belirlenmiştir.



n=8 = (p < 0.05) ve **=(p < 0.001) vs. kontrol.

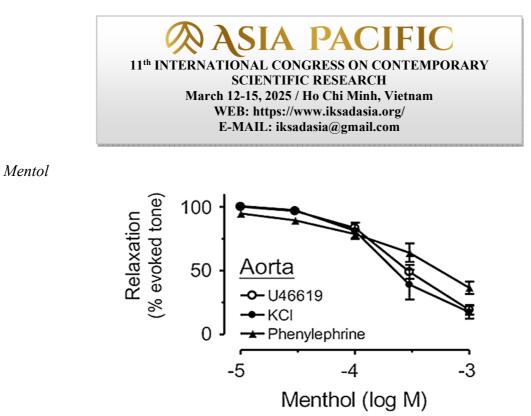
Şekil 1'de gösterildiği üzere 0,4-3,2 µg/ml aralığındaki geraniol, PHE ile kasılan sıçan aort halkalarına kümülatif olarak uygulanmıştır. Tüm dozlar, aortik halkaları anlamlı bir şekilde gevşetmiştir (Demirel, 2022).

Fenetil Alkol



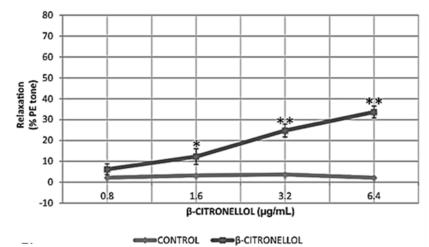
Şekil 2. PHE ile uyarılan aortik halkalar üzerine fenetil alkolün etkisi. n=6 *=(p < 0.05) vs. kontrol.

Sing ve arkadaşları, feniletil alkolün vazoaktif etkisini sıçan aortunda incelemişlerdir. PHE ile kasılan endoteli-sağlam ve -çıkartılmış aortlarda gevşetici etkiler sergilemiştir (Şekil 2). TXA₂ agonisti U46619 ve 80 mM KCl MKHS tarafından uyarılan kontraktil yanıtları inhibe etmiştir. Ayrıca, BK_{Ca} kanal blokeri TEA feniletil alkol aracılı gevşemeyi önemli ölçüde inhibe etmiştir.



Şekil 3. U46619, KCl ve PHE ile kasılan aortik halkalarda mentolün etkisi.

Mentol U46619, KCl ve PHE ile kasılan aortik halkalarda konsantrasyona bağlı bir şekilde miyorelaksan aktivite göstermiştir (Şekil 3). Mentol ile uyarılan gevşetici yanıtlar, L-NAME ve ODQ inkübasyonları ayrıca, endotel çıkarılmasından etkilenmemiştir (Cheang vd., 2013). β -Sitronellol

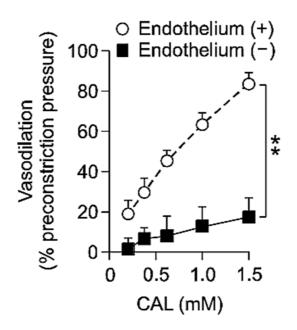


Şekil 4. PHE ile uyarılan aortik halkalar üzerine β -sitronelolün etkisi. n=8 *=(p < 0,05) ve **=(p < 0,001) vs. kontrol.

0,8-6,4 μ g/ml β -sitronellol, PHE ile kasılan sıçan aort halkalarına kümülatif olarak uygulanmıştır. 1,6, 3,2 ve 6,4 μ g/ml β -sitronellol, aortik halkaları anlamlı bir şekilde gevşetmiştir (Şekil 4) (Demirel, 2022).



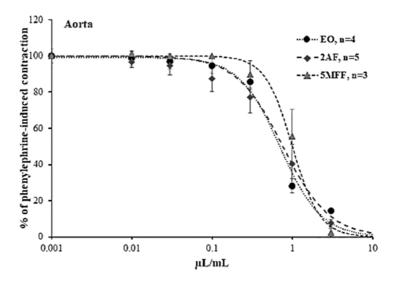
Sinnamik Alkol



Şekil 5. Endotelli ve endotelsiz aortik halkalar üzerine sinnamik alkolün etkisi. *=(p < 0.01) ve **=(p < 0.001) vs. kontrol.

Sinnamik alkol, endoteli-sağlam aortik segmentleri konsantrasyona bağlı bir şekilde gevşetmiştir (Şekil 5). L-NAME, MB ve ODQ sinnamik alkol kaynaklı relaksasyonu önemli ölçüde baskılamıştır. Sinnamik alkol, Rho-kinaz aktivatörü kalpeptin ile kasılan aortlar üzerinde inhibitör bir etki göstermiştir. Dahası, K⁺ kanal blokerleri glibenklamid ve 4-AP, sinnamik alkol tarafından üretilen relaksan yanıtları baskılamıştır (Kang vd., 2012).

5-Metil-2-Furaldehit



Şekil 6. PHE ile kasılan aortik halkalarda 5-metil-2-furaldehidin etkisi.

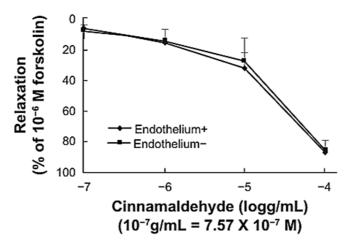


Şekil 6'da 5-metil-2-furaldehidin aortik halkaların PHE aracılı kontraksiyonlarını inhibe ettiği gösterilmiştir (Martišienė vd, 2023).

Vanilin

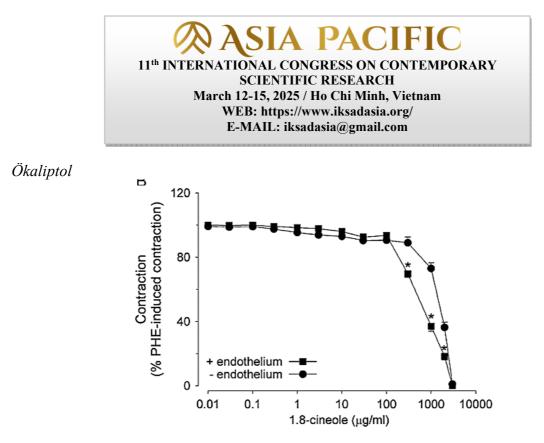
Vanilin, KCl ile kastırılmış kobay aortunda anlamlı bir değişikliğe neden olmamıştır (Jamil vd., 2018).

Sinnamaldehit



Şekil 7. Endotelli ve endotelsiz aortik halkalar üzerine sinnamaldehidin etkisi.

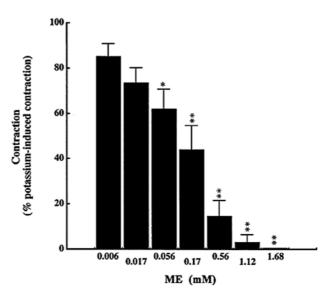
Sinnamaldehit, endotelli ve endotelsiz aort preparatlarında gevşemeye neden olmuştur (Şekil 7). Bu gevşetici etki L-NAME, ODQ, glibenklamid, TEA, BaCl₂ uygulaması ile baskılanmamıştır. Anjiyotensin II, endotelin-1, serotonin, dopamin ve PHE ile uyarılan endoteli-hasarlanmış aort halkalarını önemli ölçüde inhibe etmiştir. Endotel yokluğunda, Ca²⁺ içermeyen yüksek K⁺ solüsyonu ile depolarize edilmiş ardından CaCl₂ ile indüklenen vasküler halkalarda kontraktil yanıtları azaltmıştır. Ca²⁺ içermeyen koşullar altında PHE ile kasılan endotelsiz aort halkaları üzerinde miyorelaksan aktivite göstermiştir (Xu vd., 2011).



Şekil 8. Endotelli ve endotelsiz aortik halkalar üzerine ökaliptolün etkisi. n=12 (endotelli) ve n=11 (endotelsiz) *=(p < 0.05) vs. kontrol.

Ökaliptol, endoteli-sağlam aort segmentlerinde PHE aracılı kasılmaları anlamlı bir şekilde azaltmıştır. Ökaliptol ile indüklenen vazorelaksan etkiler L-NAME, INDO ve TEA tarafından önemli ölçüde yok edilmiştir (Şekil 8) (Pinto vd., 2009).

Metil Öjenol



Şekil 9. Yüksek K+ ile kasılan aortik halkalarda metil öjenolün etkisi. n=6 *=(p < 0.05) ve **=(p < 0.01) vs. kontrol.

Şekil 9'da metil öjenolün yüksek K^+ ile indüklenen sıçan torasik aort halkaları üzerinde inhibitör bir etkiye sahip olduğu gösterilmiştir (Lahlou vd., 2004).



TARTIŞMA ve SONUÇ

Bu veriler, geraniol, fenetil alkol, mentol, β -sitronelol, sinnamik alkol, 5-metil-2-furaldehit, vanilin, sinnamaldehit, ökaliptol ve metil öjenolün aort düz kası üzerinde damar gevşetici etkilerini göstermektedir. Ancak, altta yatan mekanizmaların aydınlatılması için daha fazla çalışmaya ihtiyaç vardır.

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ROLES OF FLAVONES ON SMOOTH MUSCLE FUNCTION

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ABSTRACT

Introduction and Purpose: Flavones are flavonoids found in the various parts of vegetables and fruits. Flavones have many pharmacological properties, including antioxidant, anti-inflammatory, cardioprotective, anti-diabetic, and anti-cancer. This review aims to provide the roles of flavones on smooth muscle function.

Materials and Methods: A literature search was conducted on PubMed, Science Direct, WoS, ResearchGate, and Dergipark electronic databases. We detected 13 flavone chemical compounds that influence the contractility of smooth muscle.

Results: Nobiletin inhibited PE-/KCl-induced contractile responses of the aorta with endothelium. ODO suppressed vasorelaxation against nobiletin in denuded endothelium; however, IBMX enhanced nobiletin-evoked relaxation. Iberiotoxin and glibenclamide decreased the inhibitory effect of nobiletin. Tangeretin relieved sphingosylphosphorylcholinemediated contraction of coronary artery strips via antagonizing the Fyn/Rho-kinase signaling cascade. Luteolin abolished spontaneous contractions of colonic smooth muscle. This spasmodic effect was attenuated by BayK8644. Luteolin 7-O-glucoside, a flavonoid glycoside, had an excitatory effect on spontaneous and ACh-induced contractions in the jejunum. Acacetin caused endothelium-dependent relaxation in spontaneous hypertensive rats. Pinocembrin hindered contractions induced by Ang II in endothelium-deprived aortic rings through the downregulation of Rho kinase-1. Apigenin elicited bronchorelaxation by inhibiting PDE and extracellular Ca²⁺ influx. Prunetin resisted contractions in the aorta via the blockage of some Ca²⁺ channels, such as VDCC, ROCC, and RyR. Baicalein induced both vasorelaxation and vasocontraction, depending on the doses used. Chrysin produced relaxant effects on aortic rings, possibly via the NO-cGMP pathway. Wogonin evoked the vasorelaxant responses by inhibiting plasmalemmal Ca^{2+} influx and Ca^{2+} release from intracellular stores. Genistein reduced NaF-stimulated contractions of tracheal smooth muscle. Kaempferol-induced relaxation was independent of pulmonary artery endothelium.

Discussion and Conclusion: This study suggested that flavones, such as nobiletin, tangeretin, luteolin, luteolin 7-*O*-glucoside, acacetin, pinocembrin, apigenin, prunetin, baicalein, chrysin, wogonin, genistein, and kaempferol, are involved in smooth muscle function. Further studies are required to understand its underlying mechanisms better.

Keywords: Flavones; smooth muscle; relaxation; contraction

GİRİŞ

Flavonlar, bitkilerde yaygın olarak bulunan ve önemli biyolojik aktivitelere sahip fenolik bileşiklerdir. Flavonlar 15 karbonlu bir yapıya sahip olup, iki benzen halkası (A ve B halkaları) arasında bir oksijen atomu ile bağlanmış üç karbonlu bir köprüye sahiptir.



Bu yapılarının, flavonların güçlü antioksidan özelliklerini sergilemelerine olanak tanıdığı gösterilmiştir (Bohn vd., 2021). Flavonlar, flavonoid sınıfının bir üyesidir. Flavonlar antiinflamatuvar, antikanserojen ve bağışıklık sistemini düzenleyici etkilere sahiptir (Santos vd., 2022). Flavonlar, doğal bileşikler olarak sağlık açısından büyük bir öneme sahip olup, özellikle kronik hastalıkların önlenmesi ve tedavisinde önemli bir rol oynamaktadır.

Flavonlar, güçlü antioksidan özellikleri sayesinde serbest radikalleri nötralize ederek damar endotel hücrelerini oksidatif hasardan korur, böylece ateroskleroz gibi hastalıkların ilerlemesini engeller. Flavonların vazodilatör etkisi, kan akışını artırarak kardiyovasküler sağlığı iyileştirir (Sharma vd., 2022). Klinik araştırmalar, flavonların kalp-damar hastalıklarının tedavisinde yardımcı terapötik ajanlar olarak potansiyel sunduğunu göstermektedir (Singh vd., 2021).

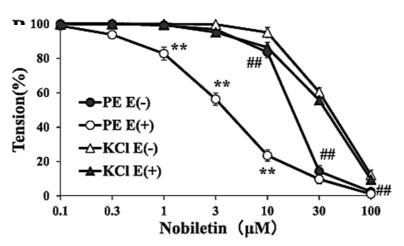
MATERYAL ve METOT

Bu çalışmada, düz kas kontraktilitesini etkileyen flavonların belirlenmesi amacıyla kapsamlı bir literatür taraması yapılmıştır. Tarama, PubMed, Science Direct, Web of Science (WoS), ResearchGate ve Dergipark elektronik veri tabanlarında gerçekleştirilmiştir. Literatür taraması sırasında, "flavones", "smooth muscle", "contractility", "contraction" ve "relaxation" anahtar kelimeleri kullanılarak, düz kas fonksiyonu üzerinde etkili olan 13 flavon tespit edilmiştir.

BULGULAR

Bu çalışmada gerçekleştirilen literatür taraması sonucunda, düz kas fonksiyonunu etkileyen çeşitli flavonlar tespit edilmiştir. Bu flavonlar; nobiletin, tangeretin, luteolin, luteolin 7-*O*-glikozit, acacetin, pinosembrin, apigenin, prunetin, baicalein, chrysin, wogonin, genistein ve kaempferol olarak belirlenmiştir.

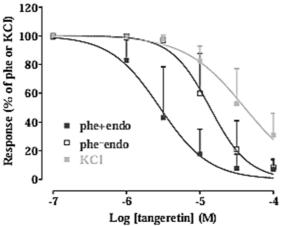
Nobiletin



Şekil 1. PHE veya KCl ile uyarılan aortik halkalar üzerine nobiletinin etkisi. **=(p < 0,01) ve ##=(p < 0,01) vs. kontrol.

Nobiletin, endoteli-sağlam ve -hasarlanmış aort halkalarında PHE veya KCl aracılı kontraksiyonları azaltmıştır (Şekil 1). ODQ, endoteli-hasarlanmış aortik halkalarda nobiletin kaynaklı relaksayonu azaltmıştır. Ancak, endotel yokluğunda IBMX, nobiletin tarafından indüklenen gevşetici yanıtları artırmıştır. İberitoksin ve glibenklamid, nobiletinin inhibitör etkilerini baskılamıştır (Kaneda vd., 2019).

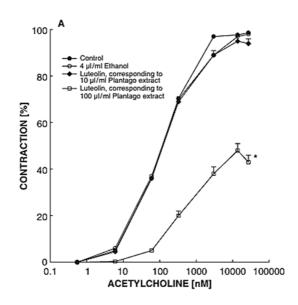




Şekil 2. PHE veya KCl ile uyarılan aortik halkalar üzerine tangeretinin etkisi.

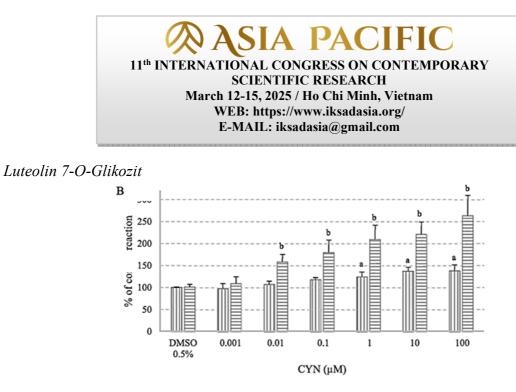
Şekil 2'de gösterildiği üzere tangeretin, aort halkalarının PHE-/KCl aracılı kontraksiyonlarını azaltmıştır (Ramunno vd., 2024).

Luteolin

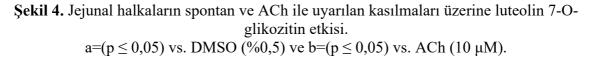


Şekil 3. ACh ile uyarılan ileal halkalar üzerine luteolinin etkisi. *=(p < 0.05) vs. kontrol.

Luteolin, ACh ile kasılmış ileum preparatlarını gevşetmiştir. Ayrıca, baryum tarafından kasılan trakeal zincirlerde bronkorelaksan etki göstermiştir (Şekil 3) (Fleer ve Verspohl, 2007).

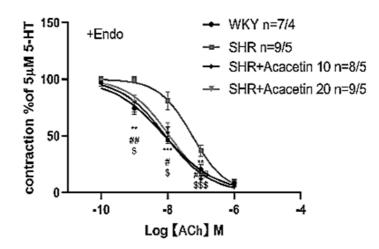


□ effect on the spontaneous activity □ effect on ACh-induced contraction



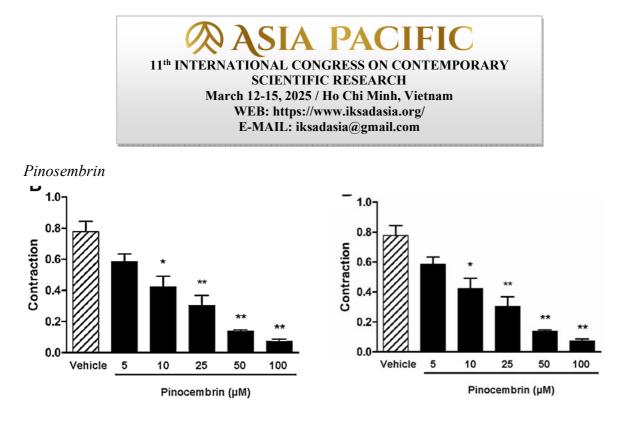
Luteolin 7-O-glikozit, jejunal düz kasın ACh aracılı kasılmalarını güçlendirmiştir (Şekil 4) (Mendel vd., 2020).

Acacetin



Şekil 5. Spontan hipertansif sıçanların mezenterik arterleri üzerine acacetinin etkisi.
=(p < 0,01) ve *=(p < 0,001) WKY grup vs. SHR grup; #=(p < 0,05), ##=(p < 0,01) ve ###=(p < 0,001) SHR+acacetin 10 grup vs. SHR grup; \$=(p < 0,05) ve \$\$\$=(p<0,001) SHR+Acacetin 20 grup vs. SHR grup.

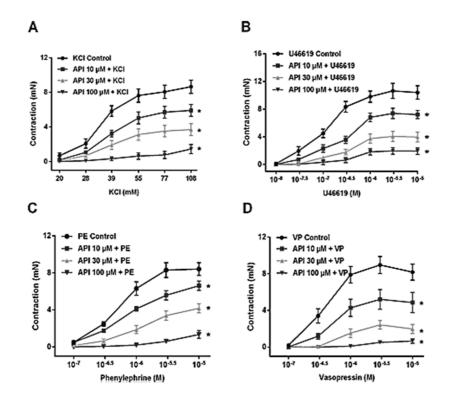
SHR'lere intraperitoneal olarak verilen acacetin, ortalama arteriyel basıncını düşürmüştür. Acacetin, serotonin ile kasılan endotelli aortik halkaları gevşetmiştir. Bu relaksan yanıtlar, L-NAME uygulaması ile baskılanmıştır (Li vd., 2022).



Şekil 6. Ang II ile kasılmalan endotelli ve endotelsiz aortik halkalar üzerine pinosembrinin etkisi. n=6.

Pinosembrin, endoteli-sağlam ve -çıkartılmış aort halkalarının Ang II aracılı kasılmalarını ihibe etmiştir (Şekil 6). Pinosembrinin AT1R'nin aktif bölgesine bağlandığı moleküler kenetleme (docking) yöntemi kullanılarak gösterilmiştir. Sonuç olarak, pinosembrin Ang II kaynaklı kontraktil yanıtları AT1R-Ca²⁺-ERK sinyal kaskadı aracılığıyla azaltmıştır (Li vd., 2013).

Apigenin

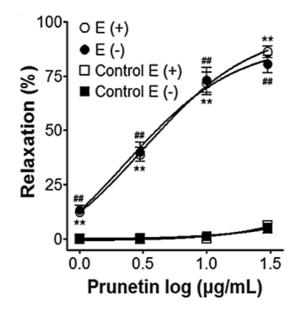


Şekil 7. KCl, U46619, PHE veya vazopressin ile uyarılan intrarenal arterler üzerine apigenin etkisi. *=(p < 0,05) vs. kontrol.



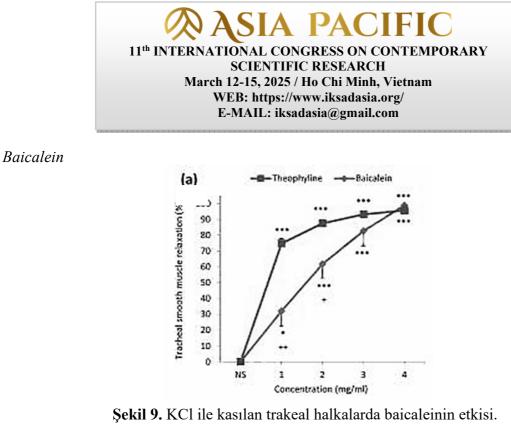
Şekil 7'de gösterildiği gibi apigenin KCl, U46619, PHE ve vazopressin ile indüklenen intrarenal arterlerde gevşemeye neden olmuştur. BaCl₂, INDO, klorür deprivasyonu, NFA, CaCCinh-A01, L-NAME ve 4-AP apigenin tarafından üretilen relaksasyonu inhibe etmiştir. Apigenin, CaCC akımını azaltmış ancak Kv akımını artırmıştır (Jing vd., 2019).

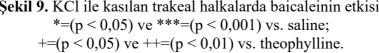
Prunetin



Şekil 8. Endotelli ve endotelsiz aortik halkalar üzerine prunetinin etkisi. **=(p < 0.01) ve ##=(p < 0.01) vs. kontrol.

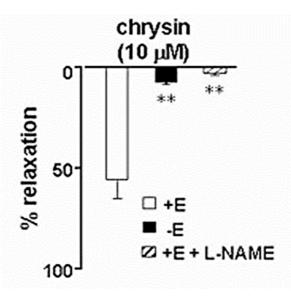
Prunetin, endoteli-sağlam ve -çıkartılmış aortlarda relaksasyona neden olmuştur (Şekil 8). Ca^{2+} içermeyen Krebs-Henseleit solüsyonunda $CaCl_2$ ile indüklenen endotelsiz vasküler halkaların kontraktil yanıtlarını azaltmıştır. Kafein tarafından uyarılan kasılmaları da inhibe etmiştir. Ayrıca, SHR'lerde sistolik kan basıncını önemli ölçüde düşürmüştür.





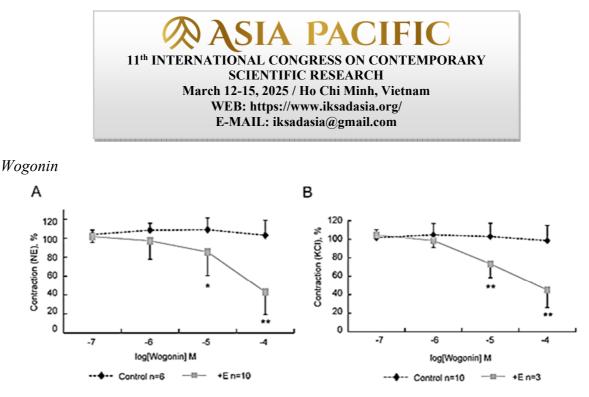
Baicalein, KCl veya metakolin ile uyarılmış trake düz kasında bronkorelaksasyonu tetiklemiştir (Şekil 9). Glibenklamid, propranolol ve klorfeniramin, baicalein-aracılı gevşemeyi bloke etmiştir (Saadat vd., 2019).

Chrysin



Şekil 10. Endotelli ve endotelsiz aortik halkalar üzerine chrysinin etkisi. *=(p < 0.05) ve **=(p < 0.01) vs. endotelli kontrol.

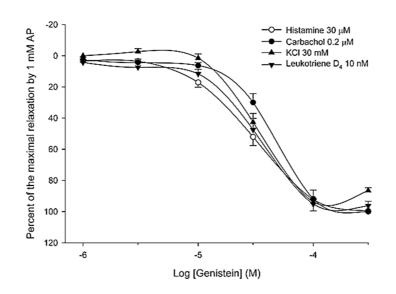
Şekil 10'da chrysinin endotelli aort halkalarının PHE kaynaklı kontraktil tepkilerini baskıladığı gösterilmiştir. Bu inhibitör etki, L-NAME ile baskılanmıştır (Villar vd., 2005).



Şekil 11. NE veya KCl ile kasılan aortik halkalarda wogoninin etkisi. *=(p < 0.05) ve **=(n < 0.01) vs. kontrol.

Qu ve arkadaşları, wogoninin endoteli-sağlam aort halkalarında NE veya KCl aracılı kontraksiyonları azalttığını belirtmiştir (Şekil 11).

Genistein

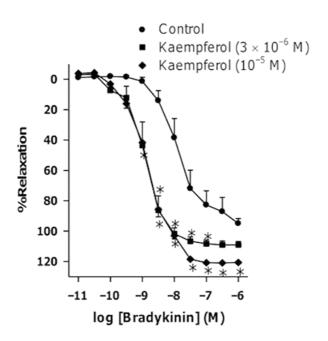


Şekil 12. Histamin, karbakol, KCl veya lökotrien D4 ile uyarılan trakeal halkalar üzerine genisteinin etkisi.

Şekil 12'de gösterildiği üzere genistein histamin, karbakol, KCl veya lökotrien D4 ile kasılan trakeal preparatları doza bağlı bir şekilde gevşetmiştir. Genisteinin relaksan etkileri, fosfodiesterazın inhibisyonu ile ilişkilendirilmiştir (Lin vd., 2007).



Kaempferol



Şekil 13. Bradikinin aracılı relakasyon üzerine kaempferolün etkisi. n=8-10 = (p < 0.05) vs. kontrol

Kaempferol, koroner arterlerde bradikinin kaynaklı relaksan tepkileri artırmıştır (Şekil 13). L-NAME, ODQ ve TRAM-3+UCL 1684 kaempferol-aracılı gevşetici yanıtlar üzerinde bir değişikliğe neden olmamıştır. Ancak, TEA ve iberitoksin azaltmıştır. Bu flavon, koroner arterlerde SNP kaynaklı relaksan tepkileri de güçlendirmiştir. Kaempferolün bu vazoaktif etkisi iberitoksin tarafından inhibe edilmiştir. Bununla birlikte, kaempferol dışa doğru K⁺ akımlarını uyarmıştır (Xu vd., 2015).

TARTIŞMA ve SONUÇ

Bu derleme çalışması, belirli bazı flavonların çeşitli dokulardan düz kaslar üzerindeki olası etkilerini sunmaktadır. Ancak, altta yatan mekanizmaların aydınlatılması için daha fazla çalışmaya ihtiyaç vardır.

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THE PEDAGOGICAL IMPACT OF MICROSOFT DESIGNER: A SURVEY ON EDUCATIONAL DEVELOPMENT

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Abstract

The integration of AI-empowered tool such as Microsoft designer into educational paradigm has helped educators as well as students to enhance the creation of visual appealing materials used for interactive presentation. Microsoft Designer is an AI driven graphic design interface that empowers users to create high-grade visual content with minimal effort. Creating visual content is a crucial element in learning and communication process, as it help both educators and students to present visual concepts and share their ideas in the most productive manner. This paper is a mixed review on the impact of Microsoft Designer on teaching and learning process. The paper explores the impact of Microsoft Designer, focusing on its applications and benefits in education. In order to collect relevant information for the paper write-up, questions were carefully constructed and administered to respondents using online Google form. The responses gathered were subjected to reliability analysis. Finally, the paper concludes that Microsoft Designer is a powerful AI driven tool that serves various categories of users, from students to professionals, enhancing visual creativity without prior design experience.

Keywords: Artificial Intelligent, Microsoft Designer, Educational Development.

INTRODUCTION

Microsoft Designer is an AI driven graphic tool developed to assist users in creating high-



quality designs with ease. This innovative design platform provides both amateurs and professionals with user-friendly interface and rich set of features to bring their ideas to reality. Microsoft Designer offers a vast library of images, icons, and templates along with smart design suggestions tailored to the specific needs of its users. The use of Microsoft Designer is highly important to the education sector, offering students, teachers as well as educational institutions a suitable way of creating stunning visual contents. Students can use this amazing tool to visualize concepts, create presentation, and share their ideas in astounding ways; Teachers can use the same tool to create visual teaching aids such as Infographics, charts and diagrams that simplifies information: and Educational institutions can produce high-quality visual

design to improve the overall quality of presentation. While Microsoft Designer allows its uses to create polished visuals without the need for additional software, it also provides basic photo-editing capacities.

RELATED LITERATURE

In recent years, Artificial Intelligence (AI) has significantly impacted on user experiences, facilitating the delivery of solutions in various sectors (Lu, et al., 2022). The studies of Abbas, et al. (2022), Chen, et al (2019) & Nikiforova, et al. (2021) reveal that the use of AI capabilities to improve design processes is becoming more popular. By leveraging AIpowered tools, users can gain valuable insights and generate innovative design (Bergstrom, et al., 2022, Verganti, et al., 2020, & Chalyi, 2024). Dave (2024) sees Microsoft Designer as a complete AI-enabled application paradigm that can be used to create AI images, stickers, invitations, wallpapers, avaters and icons, including the ability to remove backgrounds. Microsoft Designer has all the tools a non professional designer needs to create pleasing graphics for social media and more (Shelby, 2023). According to Suh & Ahn (2022), Education is one of the several sectors that is using AI-powered tools such as Microsoft Designer to improve the quality of services for teachers and students. However, there are a number of challenges for the integration of AI-driven tools in education. For example, Halaweh (2023) noted the concerns that students may copy and paste content from some sites which is tantamount to plagiarism. Elliott & Soifer, 2022; Hu & Min, 2023; Saura et al., 2022) emphasized that user privacy is another important issue to worry about.

Applications of Microsoft Designer for education

Microsoft Designer is a graphic design application tool that can be used to create classroom posters, worksheets, and other designs for classroom teaching and learning. Viz:

1. Classroom posters:



Microsoft Designer can be used to create posters that will make learning more engaging and fun-fill in order to inspire students.

2. Classroom worksheets:

add



This refers to a loose piece of paper that children use to answer questions or complete a task. Microsoft Designer can be used to graphics to worksheets .

3. Group Tutorial:



Microsoft Designer can be used to create customized learning sheets with fun images for group discussions by simply describing they want to create through text prompts.

Benefits of Microsoft Designer in education

Using Microsoft Designer in education has numerous advantages. Viz:

1. Visual appeal and creativity:

Microsoft Designer features allow teachers to create attractive visual content that can get their attention of students and invariably improve their information retention.

2. Enhancing student presentations:

Microsoft Designer features allow students to create engaging visual presentations that can improve their confidence and communication skills.

3. Promoting differentiated learning:

Microsoft Designer features allow teachers to create customized visual contents that can cater for different learning styles within the classroom.

4.Ease of use and accessibility:

Microsoft Designer interface allows various teachers to create high-quality visual contents, minimizing time spent on teaching and design.

5. Visualizing complex concepts:

Microsoft Designer features allow users to create flowcharts, diagrams, and illustrations that can simplify concepts that are complex or abstract in nature.

6.Customization options:

Microsoft Designer offers features that allow for customizing options, enabling teachers to tailor content to specific subject areas.

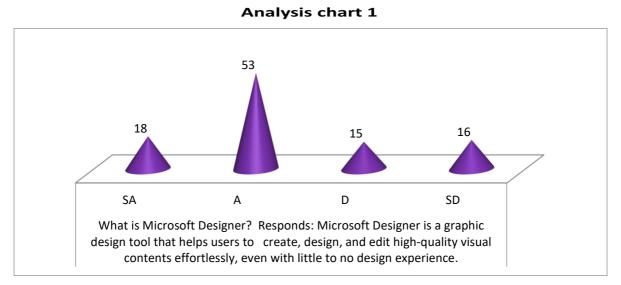
MATERIALS AND METHODS

This paper adopts a mixed review approach on the impact of Microsoft Designer in education, focusing on its applications and benefits. The researcher used qualitative approach to collect relevant information by interviewing 23 students,10 educators and 5 IT professionals from 5 selected schools of higher learning in Nigeria. In order to gather other data deemed necessary for the paper discussion, carefully formed questions were administered to respondent using online Google form questionnaire instrument. The responses collated were subjected to Cronbach's alpha reliability analysis. The result of 0.78 gave a good reliability index of the instrument. The entire exercise took place within 34 days before completion.

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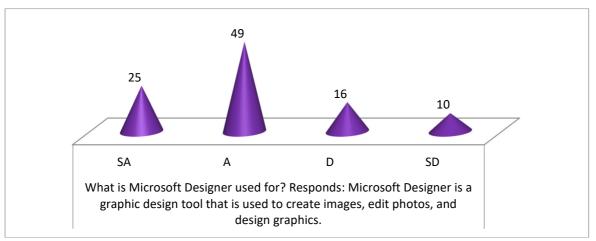


RESULTS AND DISCUSSION



The graph plotted in chart 1 reveals that a very huge number of respondents sees *Microsoft Designer* is a graphic design tool that helps users to create, design, and edit high-quality visual contents effortlessly, even with little to no design experience. The respondents further added that Microsoft Designer is a graphic design is empowered by Artificial Intelligence (AI) tool that enables users to quickly generate many variations of a graphic design with just a few clicks. According to the respondents, Microsoft Designer can creates eye-catching images with voice command, create craft next-level designs that pop, and even edit photos like an expert.

Analysis chart 2

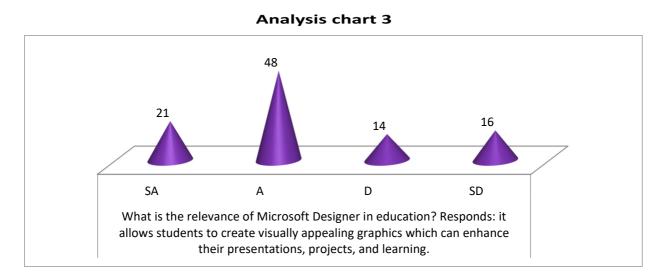


The graph plotted in chart 2 depicts that a greater amount of respondents explained that Microsoft Designer is a graphic design tool that is used to create images, edit photos, and design graphics. According to the respondents, Microsoft Designer is an AI-powered graphic design app that makes design process quicker, helping users to create amazing social media posts, invitations, postcards, and more, all within the twinkling of an eye. Microsoft Designer can help users to generate customized designs and offer personalized recommendations.

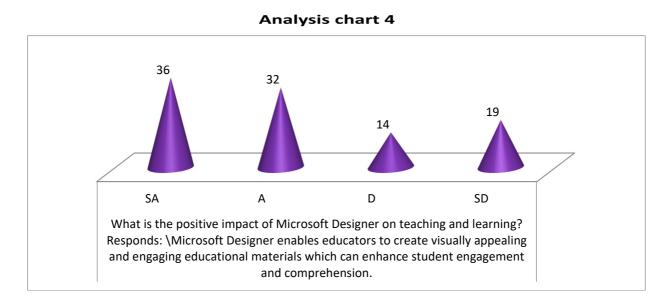
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The respondents also added that Microsoft Designer can assist users to create and edit various visuals using generative AI prompts.



The graph plotted in chart 3 shows that most of the respondents supports that Microsoft Designer is relevant in education because it allows students to easily create visually appealing graphics and designs using AI-powered tools, which can enhance their presentations, projects, and learning materials, especially for subjects requiring creative expression. The respondents explained further that Microsoft Designer allows students to build future skills as it allows them to practice with the use of descriptive language in order to have deep insight of their desired outcome.

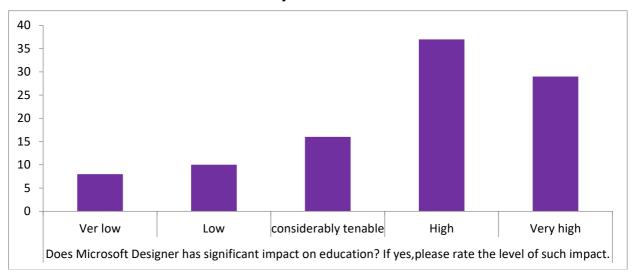


The graph plotted in chart 4 signifies that a larger number of respondents concur with the statement that Microsoft Designer enables educators to create visually appealing and engaging educational materials quickly, particularly for classroom posters, presentations, and digital learning content, which can enhance student engagement and comprehension.

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The respondents also highlighted some benefits of using Microsoft Designer in education including building collaborative classrooms, connection with colleagues, and connection other learning professionals or communities.



Analysis chart 5

The graph plotted in chart 5 implies that a large some of the respondents indicated that Microsoft Designer significantly impacts education. According to the respondents, Microsoft Designer allows both teachers and students to create visually appealing content, very good-looking educational materials, and posters with little or no design knowledge. The respondents also added that Microsoft Designer design capabilities essentially helps students to enhance their engagement, articulate and improve their overall learning experiences.

CONCLUSION

Microsoft Designer is a powerful AI driven tool developed to assist users in creating highquality designs in the most effective manner without much effort on the part of the users. In education, Microsoft Designer has played remarkable roles, offering students the opportunities to visualize concepts, create presentation, and shares their ideas in astounding ways; helping teachers to create visual teaching aids that simplify the conveyance of information; and improving the overall quality of visual design in educational institutions. Moreover, Microsoft Designer has made design processes more accessible and efficient, enabling users to focus on the most effective way of delivering their messages. Microsoft Designer has the potentials that serve various categories of users, from students to professionals, enhancing visual creativity without prior design experience.

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THE PROSPECTS AND CHALLENGES OF THE PEDAGOGICAL APPLICATION OF GENERATIVE AI: A SURVEY FOR EDUCATIONAL MANAGEMENT

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Abstract

The emergence of generative artificial intelligence (AI) technologies has open up a wide range of opportunities, while generating significant debate in education. Generative AI is a subset of artificial intelligence that utilizes machine learning models to create innovative content, such as text, images or music based on structure or pattern learned from existing data. However, the study of West & Allen (2018) noted that the integration of Generative AI into education has raised certain concerns. This paper is a mixed review on the prospects and challenges of the pedagogical application of Generative AI. The paper discussed the application of Generative AI, the benefits and the challenges of implementing Generative AI in education. In order to simplify the process of gathering useful data for the paper write-up, questions were formulated and appropriately administered to respondents using online Google form questionnaire instrument. In conclusion, the paper inferred that Generative AI has remarkably impacted education, but there is a need for proper evaluation of the information generated by AI technologies. Finally, recommendations were made.

Keywords: Pedagogical Application, Generative AI, Educational Management.

INTRODUCTION

The term 'Generative artificial intelligence' (GenAI) refers to computational technologies



that utilize machine learning models to perform various tasks, such as answering questions, summarizing texts, writing essays, creating captions, and generating stories, based on patterns and structures that are "trained" on massive amounts of text data, such as books, articles, websites, and social media posts. The technology behind GenAI uses large language models (LLMs) to produce natural language texts based on given input, such as prompt, keyword or query. LLMs can also learn from their own outputs and are able to improve over time.



Generative AI is growingly revolutionizing the way humans work and communicate with each other in various sphere of life including the educational community. GenAI tools such as Gemini and ChatGPT are Generative Language Models, while Stagle Diffusion, Dall-E 3, and Sora are Generative Image and Video Models. Notably, ChatGPT is highly creative in human-like writing capabilities and content creation; offering accessible and personalized learning experiences for different categories of students, promoting the way teacher teach and learners learn. However, the integration of generative AI comes with both constructive and disruptive potentials.

RELATED LITERATURE

Chen et al. 2023 reveals that the development of GenAI is traced back to the 1960s. Sursala et al. (2023) noted that GenAI is a class of AI models that function by learning patterns from training datasets whose contents are generated based on those patterns. The recent introduction of GenAI has evoked much debate in various fields of life, and most especially within educational community. In terms of academic research, Dwivedi et al.(2023) noted that GenAI could help in the generation of new ideas (innovation goal) and in the improvement of writing (communication goal) and the generation of new ideas (innovation goal). The study of Jarvenpaa & Klein, (2024) signified that GenAI has the potential that promotes the process of knowledge development as it contributes to the identifying focal ideas, selection of theoretical products, and establishment of theory-building apparatus. Benbya et al. (2024) stated that GenAI can be used to discover insights that are temporary not cleared to researchers, encouraging the exploration of new knowledge and serving as stimuli for novel ideas. According to Benbya et al. (2024), GenAI's inability to grasp subjective experiences and reliance on past data may lead to misinformation and stifle innovation in knowledge development. More so, Bail (2024) recalls that the biases frequently exhibited by GenAI models reflecting the human-generated data they are trained on, perpetuating the prejudices and stereotypes present in the training data. However, Feuerriegel et al. (2024) stated that copyright violations is a significant limitation of GenAI models, as it can produce outputs that resemble existing works without the permission of the original authors. Additionally, Susarla et al. (2023) outlined the major challenges of GenAI tools, including interpretability, hallucination, and institutionalization biases.

Common Applications of Generative AI in Education

In education domain, the popular applications of Generative AI are under listed. Viz:-

Students explore the use of Generative AI to:

1.Search for creative ideas: GenAI outcome generates brainstorming ideas that improves students' creativity in school tasks.

2.Clarify the meaning of complex concepts: GenAI outcomes aids further explanation of complex or abstract concepts for students.

3.Improve quality of written work: GenAI enhances auto-correction of spelling and grammar structure.

4.Increase study efficiency: GenAI increases the accuracy of study assignment based on input prompts.

***** Teachers explore the use of Generative AI to:

1.Create new content for courses: GenAI create new content and study materials for teachers that could be used to educate their students, such as flashcards, study guides and discussion questions.



2.Design and organize course materials: GenAI's ability to create an engaging virtual learning environment for students improves lesson plans and provides appropriate learning styles to students to better understand of the course content.

3.Create personalized learning lessons: GenAI enhances personalize students' learning experiences based on their past performance and instant feedback leading to students' eagerness to learn and better academic achievements.

4. Support research work: Integrate GenAI helps teachers to quickly gather and summarize content from various sources including articles, books, and videos.

School Managers explore the use of Generative AI to:

1.Plan and distribute resources: GenAI can essentially be used for resource planning tasks, ensure good school service quality

2.Automate administrative tasks: School administrators use GenAI to process students' applications, establish HR procedures, and manage facilities.

Benefits of Generative AI in Education

The integration of GenAI into education comes with numerous advantages. Viz:-:

1.Delivers customized learning experience: GenAI helps to captures past performance of students in order to re-strategize the method those best suites the achievement of their learning needs.

2.Automates various tasks: GenAI system helps to automate teachers' repetitive tasks such as marking of attendance, writing lesson notes, emails, and report summery. This enables teachers to concentrate on other works.

3.Enhances engaging and creative courses: Educators leverage the use of GenAI to create innovative ideas and course materials that enhances class engagement.

4.Improves retention and course completion: GenAI is used by School administrators to help identify at-risk students and at the same time personally intervene in their situations in order to improve their learning retention and aid their course completion.

Challenges of Generative AI in Education

There are so many huddles encountered in implementing GenAI in education. These include:-1.Ethical and privacy concerns: The implementation of Generative AI in education is faced with concerns about safeguarding learners' information and maintaining educational fairness. Hence, the implementation should undergo rigorous procedures in order to ensure decisive outcome.

2.Need for Critical thinking skills:

Students 'over-reliance on the content generated by AI may diminish their ability to critically analyze information or have deep insight on certain subject matter.

3.Bias in AI outputs:

Certain inaccurate or discriminatory information may arise from the biases present in the trained data of some Generative AI models.

4.Academic misconduct: A very high number of students find it difficult to finish an assignment without the support of AI. However, it is very difficult for expert to detect academic malpractices enhanced with AI use.

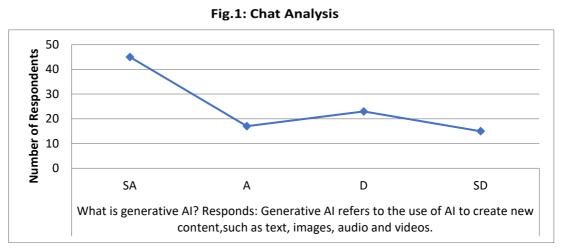
5.Limited digital infrastructure: Most institutions of learning are confronted with lack of digital infrastructure needed to empower generative AI models, while the cost of maintenance is relatively high.



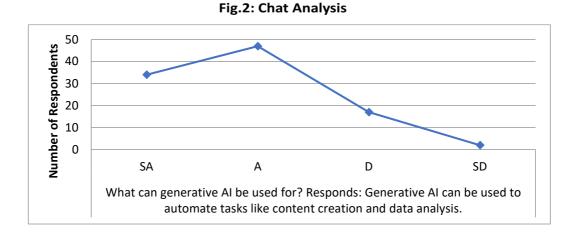
MATERIALS AND METHODS

This paper adopted a mixed review approach on the prospects and challenges of GenAI in education sector. The common applications of Generative AI, the benefits and the challenges of GenAI in education were discussed. In order to collect some information considered useful for the paper discussion, drafted copies of questions were administered to respondents using online Google form questionnaire instrument. The responses gathered were subjected to Cronbach's alpha reliability analysis. The result of 0.854 gave a good reliability index of the instrument. The entire exercise took place within thirty-seven (37) days before completion.

RESULT AND DISCUSSION

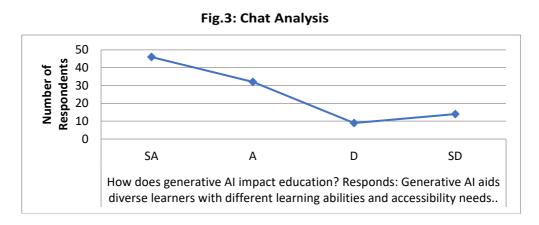


The graph plotted in figure 1 depicts that a very high number of the respondents understood the technology behind GenAI. According to their response, Generative AI or GenAI refers to the use of AI to create new content, like text, images, music, audio, and videos. The respondents explained that GenAI is powered by foundation models that can perform series of multi-task, including summarization, classification, Q&A, and many more. In addition, the respondents mentioned that GenAI create new content by identifying patterns which are used for creating new variations. In other words, GenAI systems are trained on large datasets.

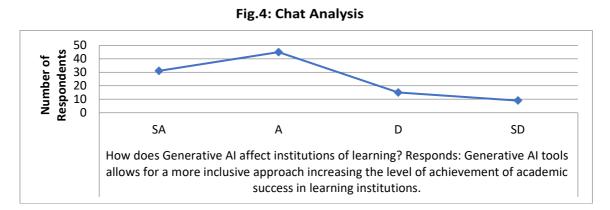




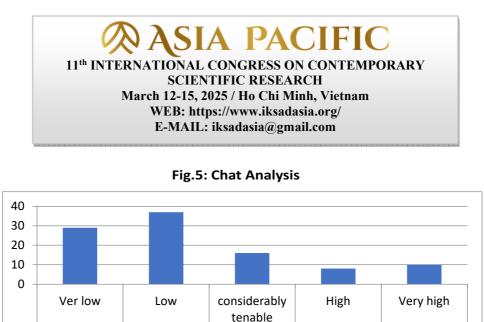
The graph plotted in figure 2 shows that most the of respondents agree with the statement that GenAI can be used to automate tasks like content creation and data analysis, thereby saving time and money. The respondents noted that GenAI allows users to focus on more strategic work, as GenAI automate repetitive or manual tasks creating a sort of relief on the part of its user.



The graph plotted in figure 3 signifies that a greater amount of respondents concur that GenAI impact education as it aids diverse learners with different learning abilities and accessibility needs. The respondents explains that GenAI is growingly revolutionizing education by providing innovative teaching tools, personalized learning, and automated assessments. The respondents added that GenAI helps to provide instant access to vast amounts of information. The respondents also emphasized that one of the significant benefits of GenAI in education is its ability to provide constructive and immediate feedback to students.



The graph plotted in figure 4 reveals that a huge number of respondents supported the statement that GenAI tools allows for a more inclusive approach thereby increasing the level of achieving academic success in various institution of learning. According to the respondents, students are able to engage themselves with material in a way that best suits their learning styles, improving academic outcomes.



Does Generative AI have negative impact on education? If yes, please rate the level of such adverse impact. The chat shown in figure 5 indicated that a few number of respondents supported that GenAI have negatively impacted education. The respondents inferred that although GenAI has

opened up a world of possibilities, its implementation in education raises a lot of concerns about copyright violations, non-ethical use, data privacy, students' overreliance on the technology and reduction in intellectual growth.

CONCLUSION

The adoption of GenAI trends in education has shown positive signs, with various students, teachers, and school administrators applying it to their work. GenAI has positively impacted education, generating numerous learning materials, facilitating easy accessibility to learning resources, enabling personalized learning experiences, and providing immediate feedback. The capability of improving academic outcomes drives more investment in GenAI solutions for education. However, it is also confronted with some challenges, including ethical and privacy concerns, need for critical thinking skills, bias in AI outputs, academic misconduct and limited digital infrastructure.

RECOMMENDATION

This paper recommends that school administrators should:

1. Discuss course policies and clearly communicate with students when and when not to use GenAI tools.

2. Consider students' accessibility to GenAI tools, especially those that students are required to interact with.

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THE IMPACT AND IMPLICATION OF AI LITERACY ON MODERN SOCIETY: CHALLENGES AND CONSEQUENCES IN EDUCATION

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Abstract

The impact of AI-based technologies has open up a wide range of growing interest in the teaching and learning of artificial intelligence (AI), while generating significant concerns on its challenges and consequences in education. Thus, education systems need to embark on the current trends in training students to live in a society where they must interact with AI. Notably, AI literacy refers to the set of competencies that enables individuals to understand the operational mechanism of AI technologies and their societal implications, along with the ability to use these technologies responsively and ethically and be able to effectively (Chiu et al., 2024). This paper is a descriptive review survey of the impacts and implication of AI literacy on society, highlighting some of challenges imposed on education sytems. For the purpose of data collection, questions were formulated and administered to respondents using online Google form questionnaire instrument. The gathered responses were subjected to reliability analysis. Conclusively, the paper inferred that AI literacy is not a mere concept but should be seen as a way of life; evolving trends that continually update socio-economy standards in response to new developments.. **Keywords**: AI Literacy, Modern Society, Challenges and Consequences, Education.

INTRODUCTION

Advancement in AI-based technology in human endeavors have led to a growing increase in



political, social and educational interest in the teaching and learning of artificial intelligence (AI) and at the same time generated significant debate on its challenges and consequences in education. However, there is a need for education systems to consider embarking on a journey to train citizens on how to live in a society where an individual have to interact with AI.



The ability for an individual to understand, interact with, and evaluate artificial intelligence technologies in an informed way is referred to as AI literacy. AI literacy is crucial in modern society as it empowers individuals to understand, navigate, and critically engage with artificial intelligence (AI) technologies that are increasingly prevalent in everyday life, impacting everything from employment to decision-making, allowing people to utilize AI tools effectively while mitigating potential risks associated with misinformation, bias, and privacy concerns. Individuals are expected to master the operational mechanisms of AI technologies and their societal implications while they responsibly communicate and collaborate with others in diverse context. An individual is also expected to show confidence in their attitude in articulate articulating the functionalities of AI technologies, understanding their societal impact. Ultimately, the individuals need to be self-assured and reflect on their understanding of AI in order to facilitate their learning experiences; focusing on the use of their proficiency in AI-based technologies for positive outcomes. This paper reviews the impacts and implication of AI literacy on society, highlighting some of challenges and consequences in education.

RELATED LITERATURE

The study of Russell (2021) explained that the advancements in Artificial Intelligence (AI) based technologies have proven to be the most socio-economic disruptive technologies ever developed. According to Russell & Norvig (2021), AI covers a large number of subfields such as machine learning, knowledge representation, natural language processing, computer vision, and many others. Integrating AI into educational curriculum is therefore important to prepare and equip citizens to be able to continue to live and survive in a world trending with the presence of AI. Hence, Heintz (2021), noted that it is crucial to introduce the teaching of AI teaching from the earliest stages of education. Kandlhofer et al. (2016) pointed out that some researchers believe that AI education should be given the same priority as literacy in reading and writing, since many jobs are now AI-related and will continue to increase in the coming years. According to Du Boulay (2016), AI literacy goes beyond using AI applications (such as Intelligent Tutoring Systems) in education. Long & Magerko (2020) and Miao et al.(2021) sees AI literacy as a set of skills that ensure the deep understanding of AI through three priority axes: learning about AI, learning about how AI works, and learning for life with AI. Wang et al. (2023) defined AI literacy as the ability to know and comprehend AI-based technologies in practical applications while fostering the awareness for reciprocal rights and of personal responsibilities. Several studies have reviewed some of the applications of AI in education sector. The study of Guan et al. (2020) reviewed some of the use of AI techniques in education over a few decades backward. The study of Chen et al.(2020) worked on the use of AI techniques as back up for teaching and learning process while the study of. Ng et al. (2022) examined teaching tools, learner type and pedagogical approaches in AI teaching and learning methods. Micheuz (2020) revealed that acquiring knowledge through AI poses a cognitive challenge for students and a huge pedagogical challenge for teachers as well as professionals.

Benefits of AI literacy on Modern Society

There are numerous benefits derived by modern society from having the competencies and being able to leverage the knowledge of AI. Viz:-



1. Critical thinking skills:

Having a deep knowledge of AI enhances the ability of individuals to ask insightful questions about AI outputs and limitations, promoting critical thinking.

2. Digital inclusion:

Having the basic knowledge and applications of AI ensures that individuals are updated with the current trends in technology, and are able to align with global communities.

3. Enhanced career opportunities:

Various industries have integrated AI assisted mechanism into their operations, giving individuals with AI skills and competencies better chances to acquire new career paths and better job opportunities.

4. Informed decision-making:

Individuals are able to make informed decision on AI outputs when interacting with AIpowered machines, based on their knowledge of AI capabilities and potential biases in algorithms.

5. Ethical awareness:

Having an in-depth knowledge of AI operations will help individuals to appropriately comprehend and abide by the ethics surrounding AI.

Challenges and consequences of AI literacy in Education

Some of the major huddles of AI literacy in education are listed below. Viz:-

1. Privacy and Data Security Issues:

Using AI systems to analyze extensive students' data raises concerns on how to best safeguard and protect sensitive information from cyber traitors.

2. Ethical Considerations:

The implementation of AI in education raises some ethical concerns about the use of student data, the potential for manipulation, and algorithmic decision-making.

3. Bias and Fairness Concerns:

Training data on biased AI algorithms can result to perpetuate existing inequalities in education, increasing unfair advantages or disadvantages for specific set of students. 4. Digital Divide:

Demographic factors of various categories of Students determines their access to Advanced AI systems which can exacerbate existing digital disparities, creating inequalities among students that are less privileged.

5. Overdependence on AI and reduced critical thinking:

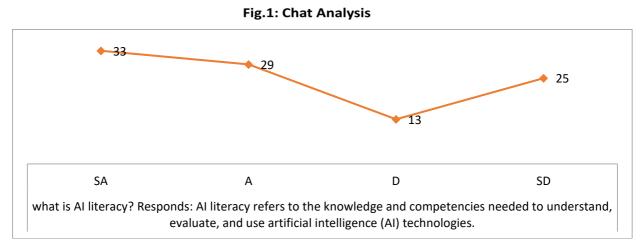
Students are prone to the danger of over relying AI-powered systems to generate solutions, resulting mal-development of critical thinking and analytical skills necessary for insightful learning.

MATERIALS AND METHODS

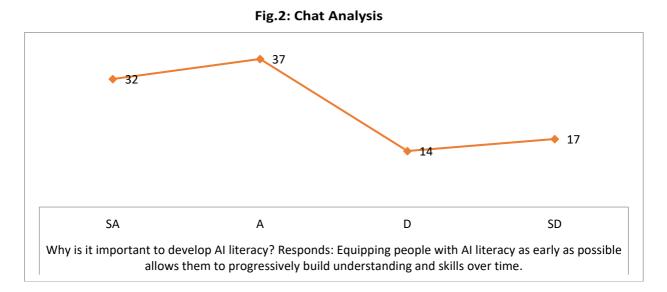
This paper adopts is a descriptive survey approach on the impacts and implication of AI literacy on society and the challenges imposed on education community. For the purpose of collecting useful information that can help in the paper discussion, drafted copies of questions were administered to respondents using online Google form questionnaire instrument. The responses gathered were subjected to Cronbach's alpha reliability analysis. The result of 0.783 gave a good reliability index of the instrument. The entire exercise took place within 47 days before completion.



RESULT AND DISCUSSION



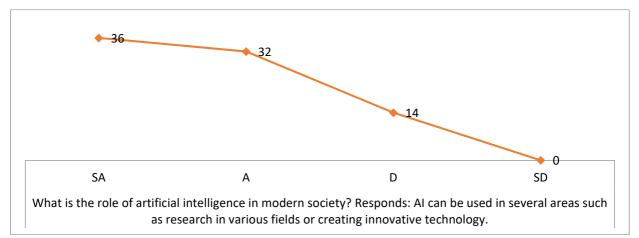
The graph plotted in figure 1 clearly depicts that a very large number of respondents reports that AI literacy refers to the knowledge and competencies needed to understand, evaluate, and use artificial intelligence (AI) technologies critically, including making insightful decisions about its application in different ways, and the ability to recognize when AI is being used, knowing its limitations. The respondents added that AI literacy includes the skills that enable individuals to have deep understanding and be able to use AI technologies safely, while effectively participating in an AI-driven world.



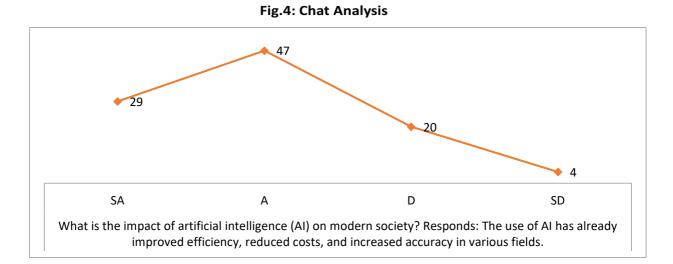
The graph plotted in figure 2 shows that a greater amount of the respondents agree with the statement that equipping people with AI literacy early in life allows the individuals to progressively develop their knowledge and skills over time. For instant, individuals with AI literacy can use data generated to make strategic and informed decisions, thereby minimizing potential risk, reducing resistance to change, and promoting innovative culture



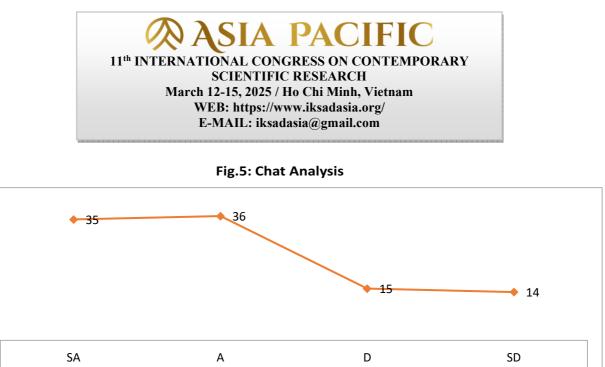




The graph plotted in figure 3 signifies that a higher number of the respondents concur with the statement that AI can be used for research in several areas and for creating innovative systems. The respondents gave examples of the use of AI in fields such as autonomous vehicles, medicine, etc to improve work efficiency and accuracy.



The graph plotted in figure 4 reveals that a huge number of respondents supported that the use of AI has already improved efficiency, reduced costs, and increased accuracy in various fields. According to the respondents, AI is increasingly becoming important in today's digitalized world as it is growingly pivoting and revolutionize numerous industries, including engineering, finance, healthcare, education, and many more.



How has AI contributed to the society at large? Responds: AI has helped to automate and increase the process speed in various industries within the society.

The graph plotted in figure 5 denotes that most of the respondents agree that AI has significantly contributed to the society at large. According to the respondents, AI has helped to automate and increase the process speed in various industries within the society, such as improving decision making, and increasing efficiency in different workplace. In addition, the respondents mentioned that AI can help identify and give solutions to problems that humans cannot solve. Finally, the respondents inferred that AI is the key driver of progress in a digitalized world.

CONCLUSION

In this paper, we have learnt about the foundational definitions and capacities of AI literacy. We have discussed how the applications of AI can help to solve problems and drive innovative societal change. The paper outlined some challenges, which include the issue ethical considerations, urging users to prioritize their use of AI, advocating for equity and critical implications of the use of AI sytems. The paper emphasized that as the impact of AI continues to be felt in various industries, AI literacy skills can be leveraged by integrating AI into the teaching process of core subjects in higher institutions of learning. Finally, the paper inferred that AI literacy is not a mere concept but should be seen as a way of life; evolving trends that continually update socio-economy standards in response to new developments.

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VİETNAM'S ROLE IN GREATER MEKONG SUB-REGIONAL COOPERATION (GMS)

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ABSTRACT

The Mekong sub-region is located in the central region, connecting South Asia and Southeast Asia, bordering China and India; connecting the Indian Ocean with the Pacific Ocean and located at the gateway to the Strait of Malacca. This is a region with development potential, with dynamic economies and high demand for investment, trade, and infrastructure development. The Mekong sub-region is the "intersection" of one of the busiest shipping routes in the world, connecting the Asian continent with Oceania in the north-south direction; the Indian Ocean with the Pacific Ocean in the east-west direction. Therefore, the Mekong sub-region always occupies an important position in the world's balance of power and an important position in the strategies and foreign policies of major powers in international relations today. As a country in the Mekong sub-region, Vietnam has many geo-strategic advantages in the Southeast Asian region and the broader Asia-Pacific region. Therefore, Vietnam has been proactive and active in promoting its role in the strategic issues of the Mekong sub-region. Vietnam's role is prominent in the fields of socio-economics, environment, climate change response and water resource protection.

This research article aims to clarify Vietnam's role in the Mekong sub-region cooperation. The research method to clarify the research content is the method of international relations research, the method of synthesizing historical documents, along with the method of historical reality to research to obtain accurate and objective information.

Keywords: The Mekong sub-region, Vietnam, international relations, socio-economics

1. INTRODUCTION

The Lower Mekong region includes 5 countries connected by the Mekong River: Cambodia, Laos, Myanmar, Thailand and Vietnam. This is a region with great economic potential with rich resource reserves and the Mekong is a river that plays an important role in the lives of people in the countries in the river basin. Since the early 1990s, in the trend of regionalization and the need to promote economic linkages, cooperation in the Mekong has undergone a great transformation. In 1992, with the help of the Asian Development Bank (ADB), the Greater Mekong Subregion Economic Cooperation Program (GMS Program) was initiated, including members: Laos, Cambodia, Thailand, Myanmar, Vietnam and China (with 2 representative provinces: Yunnan and Guangxi). The goal of GMS is to promote and facilitate mutually beneficial economic development cooperation among Cambodia, Laos, Myanmar, Thailand, Vietnam and the two provinces of Yunnan and Guangxi (China); support GMS countries to successfully implement the Millennium Development Goals, and rapidly turn the Greater Mekong Subregion into a fast-growing and prosperous region in Southeast Asia.



As a responsible member of ASEAN and the Mekong Subregion Cooperation mechanism, Vietnam has made positive contributions. In the future, along with promoting advantages, overcoming challenges will be the driving force to help this region develop rapidly and sustainably.

2. RESULTS AND DISCUSSION

2.1. About the Greater Mekong Subregion (GMS) Cooperation Program

The Greater Mekong Subregion (GMS) is a large territory consisting of 6 countries: Cambodia, Laos, Myanmar, Thailand, China (including 02 provinces of Yunnan and Guangxi) and Vietnam, with an area of 2.3 million km2 and a population of about 350 million people. GMS is essentially a natural economic region linked together by the Mekong River, with common historical and cultural features. Since 1992, with the assistance of the Asian Development Bank (ADB), the above six countries have begun to implement a subregional cooperation program (GMS) to strengthen economic relations with each other. The goal of GMS Economic Cooperation is to build a prosperous, integrated and equitable Subregion. The immediate objective of this Program is to promote joint activities in the most potential areas (infrastructure, trade and investment, tourism, environmental protection and human resource development) to create a favorable environment for long-term economic cooperation; promote, facilitate and support mutually beneficial economic cooperation among the Subregional member countries. GMS Subregional Cooperation focuses on 9 main priority areas: Transport, Energy, Environment, Tourism, Telecommunications, Trade, Investment, Human Resource Development, Agriculture and Rural Development.

Transport and Trade Support

The GMS transport projects aim to build priority transport corridors connecting the subregion and transport connections to population centers, tourist destinations, markets and other economic activity centers.

The main transport corridors form the basis for the three main economic corridors of the GMS: (i) the North–South Economic Corridor, (ii) the East–West Economic Corridor, and (iii) the Southern Economic Corridor.

Transport and Trade Support in the GMS focuses on non-physical or "software" measures to enhance connectivity and cohesion among member countries to promote cross-border trade and investment. The GMS Cross-Border Transport Facilitation Agreement (CBTA) provides a framework for transport and trade support efforts to support efficient cross-border movement of goods, vehicles, and passengers in the subregion.

Energy and Agriculture

GMS Energy Cooperation aims to establish a competitive and integrated regional electricity market that sustainably develops the GMS's abundant energy resources, improves energy security, and improves access to modern and affordable energy.

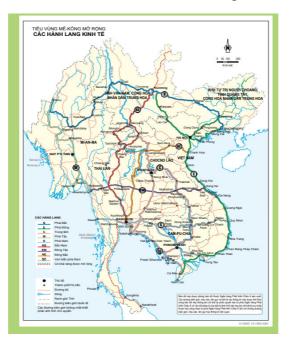
The GMS Core Agriculture Support Programme Phase II (2011–2020) envisions a subregion that is globally recognized as a leader in safe food production through climate-friendly agricultural practices and integrated with global markets through regional economic corridors. Environment

The GMS Core Environment Program aims to create a region where economic growth goes hand in hand with environmental protection, focusing on three priority themes: biodiversity and poverty reduction, climate change adaptation and mitigation, and capacity building.



Human Resources Development

The GMS human resources development strategy and action plan focuses on promoting cooperation in the areas of health, education, labor and migration, and social development.



Cooperation projects also include programs on infectious disease control, HIV/AIDS prevention, safe migration, technical and vocational training, higher education, and research. *Urban Development*

The GMS urban development sector focuses on investment in priority urban services and infrastructure in small and medium-sized cities along GMS transport corridors. In addition to preparing for population growth, these investments will also help transform transport corridors into economic corridors and improve access to jobs and markets in rural areas.

Tourism

The tourism sector in the GMS will build and promote the GMS as a single destination with a diversity of high-value, high-quality subregional products, helping to spread the benefits of tourism more widely while minimizing adverse impacts. Investment in tourism infrastructure, combined with capacity building, training and community-based tourism development, will contribute to poverty reduction, job creation and sustainable development.

Information and Communications Technology and other Border Economic Zones and Multi-Sectoral Zones

ICT efforts in the Greater Mekong Subregion aim to improve telecommunications connectivity, provide ICT applications, and support increased access to information and communications to reduce transaction costs and enhance the competitiveness of the GMS region. The GMS Strategic Framework's focus on developing economic corridors has catalyzed increased interest in special economic zones, particularly border economic zones, which require multi-sectoral coordination.

Image 1. Map of Greater Mekong sub-regional cooperation (GMS)/ Source: ADB



Developing GMS Economic Corridors

The GMS Transport Sector Strategy (2006–2015) identified nine road corridors that form the subregion's transport connectivity network. These corridors are the basis for developing "economic corridors" that combine infrastructure development with trade, investment, and other economic opportunities in specific geographic areas, complemented by efforts to address the social, environmental, and other impacts of increased connectivity.

Vietnam always attaches importance to the Mekong sub-regional cooperation mechanisms. In particular, Vietnam considers GMS and ACMECS as mechanisms of strategic significance, associated with leading important partners; and considers CLMV as a mechanism to increase the support and interest of the international community for the development of the Mekong sub-region. In the above mechanisms, Vietnam demonstrates proactive, positive participation and responsible contribution to the common interests of the region, enhances the effectiveness of sub-regional cooperation, and mobilizes external resources to serve the country's development.

2.2. Vietnam's role in the GMS

From the very beginning, Vietnam has actively participated in almost all GMS cooperation initiatives in areas such as transportation, energy, investment, information and communication, agriculture, etc. Vietnam is an important link in the GMS transport corridors and a gateway for the North-South, East-West economic corridors along the southern coast, playing a key role in implementing the GMS's "Competitiveness, Connectivity and Community Strategy" (3Cs Strategy).

Vietnam is implementing a number of major projects within the GMS framework, such as the Laos-Vietnam border power line investment project worth 218 million USD, the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project (total capital of 63.9 million USD), and the construction of an information highway connecting 6 subregions... As of June 2014, Vietnam has participated in GMS loan projects with a total capital of about 3.7 billion USD, including projects on transport, electricity, health, environment, tourism, agriculture, urban development along the economic corridor...Vietnam has participated in about 130 regional technical assistance (RETA) projects, in which ADB and other development partners supported over 120 million USD.

Some priority initiatives of the subregion that Vietnam participates in include the Cross-Border Transport Facilitation Agreement (CBTA) of GMS countries; Research on subregional transport sector strategy; Development of a Strategic Framework for Promoting Trade and Investment; GMS Business Forum; Regional Master Plan and Study on GMS Power Interconnection; Regional Power Trade Agreement; Development of the Mekong Subregion Energy Strategy; HIV/AIDS Prevention for Spontaneous Migrants, HIV/AIDS Education in Border Areas and Communicable Disease Control in the GMS; Study on Drug Eradication in the GMS; Capacity Building Program for GMS Officials under the Phnom Penh Plan for Development Management; Environmental Strategic Framework and Key Environmental Programs, including the Biodiversity Conservation Corridor Initiative; Poverty Reduction and Environmental Management in Remote Basins; Expanding Subregional Cooperation in Agriculture; Support trade promotion and capacity building in the GMS and study the construction and implementation of Cross-Border Economic Cooperation Zones (CBEZs)...



Vietnam's participation in the 5th Greater Mekong Subregion Summit demonstrates Vietnam's respect for the GMS mechanism; affirms Vietnam's role and enhances Vietnam's position in sub-regional cooperation, promotes regional cooperation and Vietnam's friendly relations with Mekong Sub-region countries; promotes and takes advantage of priority cooperation contents in line with the socio-economic development orientation, ensures Vietnam's interests, takes advantage of the strong support of the international community for efforts to manage and sustainably use Mekong River water resources; strengthens the Vietnam-Thailand Strategic Partnership (Tran, 2011).

Vietnam also actively contributed to the formation of the "GMS Tourism Strategy for the 2016-2025 period" to build the GMS region into a more competitive, balanced and sustainable tourism destination; focusing on 5 strategic implementation directions: (i) Developing tourism human resources; (ii) Improving tourism infrastructure; (iii) Enhancing the experience and quality of services for tourists; (iv) Creative marketing strategies; (v) Promoting regional-scale tourism linkages. Vietnam actively participated in tourism projects such as: Developing the tourism industry in the Cambodia - Laos - Vietnam Green Triangle and the Red River Delta Tourism Area. The riparian countries of Vietnam, Laos and Cambodia also participated in the GMS Mekong Tourism Master Plan with the following contents: Improving tourism infrastructure; community-based and pro-poor tourism development; sub-regional cooperation on sustainable tourism; and support for implementation and institutional capacity building for GMS cooperation. Vietnam also participates in the "GMS Sustainable Tourism Development" project with 3 phases, including: Phase 1, total capital for Vietnam is 8.5 million USD, phase 2 is 10 million USD, phase 3 has just signed an agreement with ADB on November 25, 2014 with a total project investment of 50 million USD (Yu, 2003). The My Tho River Wharf Tourism Development Project has helped build a park in Tien Giang, reinforce the river embankment and floating wharf, and build an additional passenger terminal. In addition, Vietnam and the GMS countries have established the Mekong Tourism Coordination Office in Bangkok, Thailand. Vietnam's active activities in the Mekong River cooperation mechanisms have contributed significantly to the development of the mechanisms as well as the development of the entire

significantly to the development of the mechanisms as well as the development of the entire Mekong region and the cooperative relations of the countries in the region. Always showing itself to be an active member, strictly complying with and promoting the spirit of sustainable development cooperation, Vietnam is often considered a leading factor, a connector and a country with enough capacity and position to make an important contribution to solving the emerging challenges facing the Mekong River region today. At the same time, Vietnam has initially proactively included the issues of water resources, environmental protection, and sustainable development in the programs and documents of larger regional and international organizations and forums, such as ASEAN, APEC, and ASEM. Vietnam's activities in recent times have achieved certain results, contributing to promoting the country's socio-economic development as well as strengthening ties with countries in and outside the region.

2.3. Solutions to enhance Vietnam's position in the GMS

First, upgrade the sub-regional cooperation content. In the context of the world economy undergoing unprecedented profound and comprehensive transformation; the trend of green transformation, digital transformation, sustainable and inclusive development has become more urgent than ever, the Mekong sub-region needs to have "breakthrough" steps to meet new development requirements (Le Dung, 2020).



New areas of cooperation are a strong driving force to position the GMS, ACMECS, CLMV mechanisms not only as traditional core mechanisms in sub-regional cooperation; but also as pioneering mechanisms to bring the Mekong sub-region to a new height in the regional and international value chain.

Second, enhance political trust among member countries. This series of events brings together all the countries along the Mekong River, which are also close neighbors with traditional friendship relations with Vietnam. Vietnam demonstrates its goodwill to cooperate in the spirit of openness, enhancing mutual understanding, contributing to deepening the friendly neighborly relations between Vietnam and member countries, as well as promoting increasingly comprehensive economic, trade and investment cooperation.

Third, raising Vietnam's position and prestige in the GMS, Vietnam always attaches importance to and contributes to promoting the GMS, ACMECS, CLMV mechanisms as well as the overall Mekong sub-regional cooperation to create breakthroughs in the new development stage. Thereby, affirming the foreign policy mindset of independence, self-reliance, diversification, multilateralization, being a friend, a reliable partner, an active and responsible member of the international community.

3. CONCLUSION

Vietnam's active activities in the Mekong River cooperation mechanisms have contributed significantly to the development of the mechanisms as well as the development of the entire Mekong region and the cooperative relations of the countries in the region. Always showing itself to be an active member, strictly complying with and promoting the spirit of sustainable development cooperation, Vietnam is often considered a leading factor, a connector and a country with enough capacity and position to make an important contribution to solving the emerging challenges facing the Mekong River region today. At the same time, Vietnam has initially proactively included the issues of water resources, environmental protection, and sustainable development in the programs and documents of larger regional and international organizations and forums, such as ASEAN, APEC, and ASEM. Vietnam's activities in recent times have achieved certain results, contributing to promoting the country's socio-economic development as well as strengthening ties with countries in and outside the region. In the future, Vietnam with its increasingly growing economy will make more effective contributions to the GMS.

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THE USE OF POETIC TECHNIQUES IN NIZAR KABBANI'S "ARABIAN LOVE POEMS"

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Abstract

The 1950s were a pivotal decade in Arabic literature, designating the complete transition to Modernism. A prominent figure embodying this transformation was the Damascene poet Nizar Kabbani, who pioneered a new poetic style that delved into human feelings with a remarkable sensitivity.

The present study intends to explore Kabbani's volume of *Arabian Love Poems*, translated into English by Bassam K. Frangieh and Clementina R. Brown, which is divided into three sections: the first contains selected verses from the *Book of Love*, the second part includes excerpts from *One Hundred Love Letters*, and the third section comprises *Other Poems*.

The article aims to analyze the variety of techniques that the Arab poet utilized in the book to evoke powerful human emotions. The research will show that, in his poetry, Kabbani employed the free verse and a picturesque style in order to voice the feelings of the modern heart. He also made use of stunning comparisons, striking analogies, cross-sensory metaphors, astonishing paradoxes, witty innovation, personification and humor to create a captivating portrayal of love that aligned with the spirit of his time.

The study will conclude that, by using these techniques, Kabbani invented a new kind of poetry that seemed truthful, simple and spontaneous, like an outpouring of the heart. From then on, his unique verses have captivated generations of readers with their vibrant and engaging style.

Keywords: poetic techniques, Nizar Kabbani, love poems, modern poetry, Arabic literature



THE LEGACY OF SOCIALIST REALISM IN KYRGYZ POETRY AND THE ARTISTIC QUEST OF POETS IN THE 1970S–80S

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Annotation

The article "The Legacy of Socialist Realism in Kyrgyz Poetry and the Artistic Quest of Poets in the 1970s–80s" delves into the influence of socialist realism on Kyrgyz literature and its impact on poetry during the 1970s–80s. The article examines how the ideology of socialist realism was preserved in Kyrgyz poetry, and despite the restrictions in its artistic practice, how poets introduced changes in their creative work.

In the 1970s–80s, despite ideological pressure, poets sought to break free from the boundaries of socialist realism, searching for new artistic forms and philosophical depth. The article analyzes the works of poets who introduced new directions in both form and content, with a focus on symbolism, metaphor, and aesthetic innovation. Through the works of prominent poets such as Suyunbay Eraliyev, Jolon Mamytov, and Tabildy Mukhanov the article explores the impact of socialist realism and its renewal, the limitations of creative freedom in poetry, and its aesthetic significance.

This study looks at changes in the poets' worldview, the limitations of literary freedom during times of ideological tension, and how these restrictions led to the emergence of new artistic features in poetry. The research examines the process of Kyrgyz poetry transcending the boundaries of socialist realism, embracing innovation, and exploring poets' artistic and aesthetic perspectives. This article is a valuable study for literary scholars, philosophers, and those interested in the development of Kyrgyz poetry.

Keywords: Arts, Humanities, Literature, Cultural Studies, Philosophy, Social Sciences, History, Human Rights, Aesthetics, Interdisciplinary Research, Visual Arts, Performing Arts, Ethics, Linguistics, Education.

Introduction

Kyrgyz poetry, in the second half of the 20th century, developed under the influence of socialist realism, resulting in works that adhered to the main demands of this ideological trend. Socialist realism, as the official direction of Soviet literature, emphasized the artistic reflection of public life, revolutionary struggle, the glorification of the working class, and the communist ideology. This study addresses the intellectualization process of Kyrgyz poetry that began in the 1960s and its social-cultural role in the subsequent decades.

The peculiarity of the period lies in the widespread popularity of works by young poets in the pop-art direction and the transition of poetry from tribune-like publicism to intellectual levels. The relevance of the study is connected to the insufficiently developed deep analysis of poetry from this period. In such a context, uncovering the reasons for the formation of the intellectual genre of poetry and its social-cultural significance is the main aim of this research.

As noted by the prominent literary critic V.A. Losev, this direction in Soviet poetry started to take shape in the 1930s and continued to dominate through the 1970s and 1980s. Researchers assess the phenomenon of the social myth in various ways. Some scholars emphasize the inevitability of the emergence of social mythology, underlining its universal nature.



A.F. Losev pointed out that mythological consciousness is characteristic of humanity across all ages and contributes to perceiving the surrounding environment as absolute reality: "Myth is (for mythical consciousness, of course) the most concrete, maximally intense, and most strained reality. It is not a fictional thing; rather, it is the clearest and truest truth" [1]. F.H. Cassidy highlighted that social myth is created by society and reflects the dreams and understandings of the world in different societies [2]. Social mythology ensures the process of creating truth and is considered a "semiotic system of values that has become ontological" for a particular society [4]. This process began to emerge in literature, including poetry, as a universal method for portraying social classes and key issues of society. During the Soviet era, socialist realism served as the primary tool for spreading social myth into creative works and was accepted as a method of artistic expression in literature and art. From 1934 to 1991, socialist realism embodied the official ideology of the USSR, developing aesthetic concepts of the world and human nature. However, socialist realism, with its strict limitations, created works in a one-sided, normative, and repetitive form [5], and following its canonical significance restricted creativity [6].

Although the influence of socialist realism continued to be strong in Kyrgyz poetry during the 1970s and 1980s, poets sought to explore individual lyrical quests and employ new artistic techniques in their works. During this period, poets stepped beyond the strict confines of socialist realism, embracing new themes and artistic forms. Notably, the philosophical depth of the works by poets such as Sagyn Akmatbekova, Jolon Mamytov, and Tabildy Mukanov reflected human inner worlds and spiritual quests through symbolism and metaphors. While the influence of socialist realism was still prominent, the creativity of poets in the 1970s and 1980s increasingly focused on individuality and philosophical reflections, despite the ideological limitations of socialism. Though socialist realism's influence remained, Kyrgyz poetry entered a new stage, with poets adopting new artistic methods and placing greater emphasis on symbolism and metaphor. This process is viewed as an effort to break free from the constraints of socialist realism and to strive for literary and artistic renewal. More specifically, the limitations of socialist realism opened the door for new perspectives, ideas, and artistic discoveries in Kyrgyz poetry.

Socialist realism began to take shape in Kyrgyz poetry primarily in the 1930s, with all its manifestations. The main goal of this movement was to reflect the achievements of socialist construction, glorify the revolutionary struggle, and strengthen the dominance of communist ideology. Poets' works were often centered on showcasing truth, revolutionary courage, and the working class at a high level. The inner world of individuals, their personal feelings, and life difficulties were largely ignored. However, during these years, the constraints of socialist realism motivated many poets to search for new visions, forms, and philosophical depth in their work. During this period, Kyrgyz poetry saw the emergence of innovations aimed at deeply understanding nature, humanity, and the inner world of individuals. Poets attempted to expand the artistic world and define individuality and inner experiences through symbolism, metaphor, and abstraction.

Many literary studies have been conducted on the influence of socialist realism and its impact on Kyrgyz poetry. These studies identify tendencies in poets' works that contradicted the main requirements of socialist realism and demonstrate their efforts to expand artistic freedom. Additionally, the philosophical and artistic aspects of the innovations in poets' works and their departure from the constraints of socialist realism have been explored.



This research delves into the influence of socialist realism and the creative innovations in Kyrgyz poetry during the 1970s and 1980s. The article analyzes the constraints of socialist realism and the innovation in poets' creativity, shedding light on significant changes in the development of Kyrgyz poetry.

1. General Concept of Socialist Realism and Its Formation in Kyrgyz Literature

Socialist realism, as the main trend of Soviet literature and art, emerged in the 1930s and required the glorification of socialist construction, revolutionary struggle, and the depiction of working people. The primary goal of this movement was to build a new society, spread socialist principles, and strengthen the dominance of communist ideology. In literature, socialist realism aimed to glorify people's social duties, revolutionary freedom, and the working class. The key principles and artistic requirements of socialist realism involved depicting socialist society and individuals in an idealized way, strengthening socialist ideas, and illustrating the victories of the revolutionary struggle. The main requirements in literature were:

1. Depicting life truthfully and optimistically – socialist realism aimed to portray natural life but focused on showcasing societal progress, revolutionary changes, and socialist construction.

2. Heroism and optimism – literature featured individuals who contributed to the development of society, fought against ideological opposition, and achieved victory.

3. Class struggle and socialist positions – all creative work was expected to be oriented towards socialist ideas and the socialist development of society.

4. Glorifying the working class – in socialist realism, the hardworking, collective individual – the one who contributed to the development of the union and the people – was glorified.

The artistic requirements of socialist realism were strictly applied in poetry, and poets were expected to construct their works in line with socialist ideology. Based on these requirements, poets created works that praised socialist society, idealized the working class, and demonstrated loyalty to socialist ideology. Thus, socialist realism forced poets to serve the state ideology, its goals, and the achievements of socialist construction.

In Kyrgyz literature, socialist realism began to form in the 1930s under the influence of Soviet politics. With the influence of Soviet ideas, the principles of socialist realism entered Kyrgyz poetry, including themes related to the people's participation in socialist construction, the victories of the working class, and the obligation to write works in accordance with socialist ideology. In poets' works, the glorification of socialist construction, the socialist realism entered Kyrgyz literature and poetry, it was largely shaped by the influence of Russian literature. In line with the requirements of Soviet ideology, socialist realism in Kyrgyz poets' works emphasized elements of socialist ideology, focusing on the development of socialist society and its characters.

At this stage, socialist realism became closely integrated into Kyrgyz literature, blending with the peculiarities of Kyrgyz poetry and compelling poets to create works that emphasized the contribution of the people to socialist construction. Although the introduction of socialist realism brought new forms, styles, and perspectives to Kyrgyz poetry, it also acted as an element that restricted artistic freedom. The creative process, aimed solely at reflecting socialist ideology, the development of society, and its ideals, posed a series of constraints and demands for poets. The influence of socialist realism found its place in Kyrgyz poetry.



Poets directed their works towards praising socialist construction, the working class, revolutionary struggle, and the building of a new society. Kyrgyz poetry during the Soviet era placed emphasis on labor, socialist development, and the dissemination of communist ideology among the people. Broadly speaking, socialist realism introduced new meanings within the framework of communist ideology to Kyrgyz poetry. Poets sought to glorify the Soviet destiny, strengthen socialist patriotism, and portray the lives of courageous workers. However, these portrayals were often presented in a one-sided, optimistic manner, rarely stepping outside the ideological limits of the artistic form.

Despite the ideological pressure of socialist realism in Kyrgyz poetry, during the 1970s and 1980s, Kyrgyz poets began to break free from the constraints of socialist realism and sought new creative paths and ideas. Many poets, striving to move beyond the limitations of socialist realism, aimed for philosophical depth and poetic innovation. These explorations, on one hand, were challenged by ideological conflicts within society at the time, but on the other hand, they opened the door to a new level of artistic freedom. Kyrgyz poets sought to explore new forms and styles in their creativity. During this period, poets like Suyunbay Eraliev, Jolon Mamytov, and Tabyldy Mukanov began searching for new forms and content in poetry. They moved beyond the boundaries of socialist realism, extensively using symbolism, abstraction, metaphor, and allegory. Their works acquired deep philosophical meanings, addressing social contradictions, the inner world of humans, and existential questions. Poets strived to deeply portray the life circumstances of individuals, their inner conflicts, and their spiritual quests. However, the ideological pressure of socialist realism limited their artistic freedom, and poets tried to subtly blend personal freedom and creative thoughts with the trustworthy aspects of socialist realism. In the creativity of Kyrgyz poets living within the constraints of socialist realism, elements of ancient Kyrgyz values, folk myths, and popular poetry were incorporated, while ideological values were also deeply embedded. As noted by A. Erkebayev, through this creative approach, poets sought to achieve artistic successes within the socialist framework without facing pressure.

The Pursuit of New Forms and Content in Poetry in the 1970s-80s

Kyrgyz poetry in the 1970s and 1980s sought to break free from the constraints of socialist realism, beginning to explore new forms and content. During this period, new, deeply philosophical themes were widely reflected in poetry, addressing changes in society and the inner world of individuals. A number of scholars have deeply analyzed the innovations in Kyrgyz poetry of the 1970s-80s, focusing particularly on the poets' creative searches for new forms and content. In their quest to escape the dogmas of socialist realism, poets sought new methods of enriching artistic language.

Literary critic A. Erkebayev's work "*Contemporary Time and Kyrgyz Poetry*" is dedicated to analyzing the social and artistic processes in Kyrgyz poetry at the end of the 20th century. The author examines the evolution of Kyrgyz poetry, its development in the social context, and its poetic explorations. Erkebayev primarily highlights authors from the 1960s-80s who reflected changes and new ideas in Kyrgyz poetry. Additionally, he analyzes the tension between the constraints of socialist realism and the rise of innovation, philosophical depth, and the widespread use of symbolism. A key aspect of this work is establishing the theoretical foundations of Kyrgyz poetry's evolution during this period, reexamining the content and form of works due to the influence of socialist ideology. In his analysis, Erkebayev notes that poets were striving to break free from the limitations of socialist realism and to use new artistic methods.



Meanwhile, A. Egemberdieva in her scholarly work provides a deep analysis of the historical development and ideological-stylistic characteristics of Kyrgyz women's poetry. She explores the themes, style, and symbolism in the works of Kyrgyz female poets. The work mainly examines the development of Kyrgyz women's poetry from social, cultural, and ideological perspectives, analyzing the historical truths and the artistic symbolism of nature in their works. The author highlights the innovations introduced by Kyrgyz women poets, particularly in expressing new aesthetic-ethical concepts and portraying their inner worlds through artistic nature. In her study, Egemberdieva explores the themes in women's poetry in depth, revealing the cultural and historical contexts of their works. Important insights are provided regarding the specific characteristics of women's poetry, including social burdens and aesthetic-ideological innovations.

Both works offer different perspectives on the unique features of Kyrgyz poetry and the influence of socialist realism. Erkebayev's work provides a profound analysis of the social and artistic transformations in Kyrgyz poetry during that time, while Egemberdieva emphasizes the distinct characteristics of Kyrgyz women's poetry and the methods they used to depict nature. Egemberdieva also appreciates the aesthetic and philosophical depth of women's poetry, aiming to define their role in the literary process of that time. Both works highlight the artistic and stylistic changes in Kyrgyz literature during the era of socialist realism, illustrating the freedom and innovation in poets' creativity. Erkebayev analyzes the attempts to break free from the constraints of socialist realism and the use of new artistic techniques, while Egemberdieva analyzes the unique creative methods of Kyrgyz women poets and the new historical concepts they conveyed in poetry. This process influenced the poetic structure, image systems, and thematic changes as follows:

• During this period, alongside classical poetic forms, free-form (vers libre) poetry began to spread widely in Kyrgyz poetry. This was especially evident in philosophical lyricism. Poets distanced themselves from traditional rhyme-based poetic structures and began using forms that reflected the free flow of thoughts. Experiments were also conducted in the rhythmic structure of verses, the volume of stanzas, and intonational decisions.

• As content innovations, while meeting the requirements of socialist ideology, poets began to address deeper lyrical and philosophical themes such as personal destiny, the philosophy of life, and the connection between nature and human beings. The works of this period emphasized the inner world of individuals, the transformation of consciousness, and the multifaceted nature of one's perspective on social life.

• Poets placed more emphasis on using symbols and metaphors to uncover the deeper meaning of thoughts, rather than directly conveying the ideas. For example, natural phenomena—mountains, wind, rivers, the moon, and stars—were used as allegories for human life, offering opportunities for reflections on life, death, love, and freedom. This served as an alternative to the direct propaganda of socialist ideology, reflecting the artistic freedom of poets.

• The artistic tools in poetry were renewed, and the emotional impact of the poems increased. The aesthetic value of the poetic texts was enhanced through musical elements in the arrangement of words, repetitions, and the harmony of sounds.

In poetry, the influence of modern literary trends grew stronger, and the artistic connections with world literature reached a new level. As a result, Kyrgyz poetry of the 1970s and 1980s became richer in both form and content, reaching a new level through symbolism, metaphor, and aesthetic innovation. During this period, poets sought poetic freedom and made efforts to break away from the restrictions of socialist dogmas.



Innovative poetic movements brought national literature closer to the global artistic development flow, increasing the philosophical depth of Kyrgyz poetry. Poets moved away from directly praising the structures of socialist ideology and the depicted societal orders, instead transitioning to expressing their thoughts in meaningful and abstract forms. The creative work depicting various aspects of life, societal issues, and individual emotions became deeply meaningful. Thus, the development of new forms and content, poetic experiments, and the expansion of artistic freedom began.

Poets' Creative Endeavors

In the 1970s and 1980s, poets such as Suyunbay Eraliev, Zholon Mamytov, and Tabildy Mukanov opened new directions in Kyrgyz poetry, breaking free from the constraints of socialist realism. In their works, they distanced themselves from the old socialist heritage and ideology and began reflecting the changes in society and the inner world of individuals.

Suyunbay Eraliev was one of the poets who brought deep philosophical reflections and natural creativity to Kyrgyz poetry. His creative work occupies a significant place in the development of Kyrgyz poetry. Starting from the early 1960s, the poet wrote lyrical and journalistic poems, deepening his poetic skills and blending innovative perspectives. The content and form of his poems were unique, bringing new energy to Kyrgyz poetry. From the early stages of S. Eraliev's creativity, his poems, such as "Journey to the Stars", "My Father, My Land, and Me", "The Road", "Cosmos Poem", "White Fragrances", and "Kyrgyz Soul", left a significant impact on Kyrgyz poetry. These poems are known for their deep philosophical reflections, dynamic narratives, and the use of new poetic techniques. In the poem "What is in Issyk-Kul?", the poet connects the beauty of Kyrgyz land, its nature, and human life, inviting the reader to engage with philosophical thoughts. Through water, sun, sand, and white swans, the author depicts the nature of Issyk-Kul, reflecting its influence on life. In this poem, S. Eraliev shows the connection between nature and the spiritual world of man, encouraging contemplation about oneself and the world.

The 1959 publication of "Ak Mör" was a major event in Kyrgyz literature. The poet reintroduced folk oral creativity as a cultural treasure and treated it with a new perspective. The artistic devices, deep psychological portrayals, philosophical reflections, and epic parallelism used in the poem represented the history, traditions, and social contradictions of the Kyrgyz people. "Ak Mör" opened new possibilities for Kyrgyz poetry and raised it to a new level. In S. Eraliev's works, features such as the melodious and vivid lines of verse, dynamic development of the narrative, and expressive storytelling are present. He is also known as a nature painter, and his poetry displays a special taste in portraying nature and connecting it to the human inner world.

S. Eraliev's creative work holds a special place in Kyrgyz poetry, as he redefined traditional poetry with a new perspective, aligning the poetic content of free verse with its form, thereby enhancing its beauty. His works have become an example for Kyrgyz poets, opening new paths in the use of new techniques and artistic methods in literature. Eraliev's poetry opened new directions in Kyrgyz literature by reflecting deep philosophical reflections of his time, social issues, and the harmony between nature and humanity. In his poetry, abstraction, allegory, and symbolism were used. Eraliev's works reflected the inner feelings and spiritual renewal of individuals, presenting a new artistic voice distinct from socialist ideology. During the 1970s and 1980s, Eraliev deepened his poetic explorations by combining social and philosophical themes with new styles, blending form and content.



His works reflected deep thoughts on the inner world of humans, life and death, the destiny of the people, and the connection with nature.

Eraliev linked nature with the human inner world, presenting people in harmonious relationships with nature. In his poetry, the forms, colors, and characteristics of nature reflect human emotions, thoughts, and dreams. He raised deep philosophical questions about death and its impact, as well as the fate of human life. The poet examined the impermanence of life and the place of humans in nature in a special, profound, and expansive way. His works addressed relevant issues such as social injustice, the place of individuals, the fate of the people, and social changes. He called on people to understand their roles and responsibilities in society. In his works, he depicted the differences between the city and the village, the life of people, and their social conditions. He also illustrated the living conditions in Kyrgyz villages and the relationships between people. Eraliev's works brought new energy to Kyrgyz poetry in the 1970s and 1980s, deepening its philosophical and social dimensions. He explored the connection between the inner and outer worlds of humans and conveyed deep thoughts with poetic mastery.

Zholon Mamytov was a poet with a unique philosophical lyricism, deep metaphors, and spiritual explorations. His works often dealt with contemporary themes, social difficulties, and thoughts about the balance within the human inner world. Mamytov's poetry sought to break free from restrictions, 444ntroduce

ing new aesthetic values. He was a shining star of Kyrgyz poetry. His poetic collections, such as "*I Love Fire*", "*The Green World*", "*Time*", "*Songs*", "*The Reflection of the Time*", "*The Tale of the Bright Dawn*", "*The Life of Water*", "*Racing Waters*", "*Put on the Saddle*", "*A Century to Live*", "*Origin and Universe*", received acclaim from literature enthusiasts. In the 1970s and 1980s, Mamytov deepened his creative work with new approaches, focusing on social and philosophical themes, and raised deep issues such as the human condition, nature, fate, and freedom. His works combined the classical traditions of Kyrgyz poetry with contemporary, relevant themes.

Mamytov explored the place of humans in society, their relationships, and social injustices and changes. In his poetic creativity, he expressed social unrest, people's needs, and destinies. The poet had a significant impact on connecting nature with the human inner world. The integrity of nature and its deep philosophical meaning formed the core of his poetry, emphasizing that humans should live in harmony with nature in their own lives. In the 1970s and 1980s, the poet wrote deeply about life, death, and raised questions about human fate and spiritual freedom. He philosophically analyzed thoughts on the transience of death and the meaning of life. The poet examined freedom, decisions emerging from the human inner world, and individuality, delving deeply into questions related to human destiny and life. He called for understanding that every person has the right to freedom and open opinions, but there are limits to this freedom. Many of Mamytov's works are dedicated to the process of human spiritual renewal and growth. As a poet, he enriched people's thoughts and meanings with his profound reflections.

Zholon Mamytov's creative work in the 1970s and 1980s held a special place in Kyrgyz poetry. His poetry, reflecting the social and philosophical life of that time, proposed a deep focus on the human inner world and social position.

Tabyldy Mukanov is known in modern Kyrgyz poetry for his deep philosophical views and artistic techniques. Through his works, Kyrgyz poetry sought to break free from the constraints of socialist realism and the established artistic norms. Mukanov revived elements of folk poetry, gaining creative freedom through metaphors and symbols.



His poetry collections reveal the deep philosophical, lyrical, and emotional aspects of his creativity. Each collection consists of works that depict the poet's personal world, social issues, and the fate of humanity.

1. "The Girl Who Lost Her Needle" (1973): This poetry collection is a clear example of the poet's early works. The title alone reflects its content, as the image of a girl who lost her needle symbolizes significant themes, emotions, and challenges in a person's life. The brevity and deep meaning of the poems are designed to fully satisfy the reader.

2. "The Land of Wrinkles" (1976): In this collection, the poet's views on life and nature are further developed. While he harmoniously reflects on natural phenomena and the human inner world, he also deeply considers the social and human issues of that time.

3. "The Heartbeat" (1980): This poetry collection encompasses the bright stages of the poet's lyricism. The title itself shows the close connection between human inner feelings, nature, and love. The depth of emotion and philosophical reflections are key characteristics of this poetry.

4. "The Soul" (1986): This collection showcases the refined form of the poet's poetry. It contains reflections on various aspects of the soul, love, sorrow, fate, and the philosophy of life. The size and content of the poems, along with the poet's deep thoughts, engage the reader, leading them to profound analyses with every word.

5. "Like a Green Juniper: Letters, Memoirs, Poems" (2002): This collection gathers the poet's works over many years of creative life. It includes not only poems but also letters and memoirs. Some parts of the collection provide interesting insights into his personal world, creativity, and literary heritage.

Tabyldy Mukanov's poetry collections hold a special place in Kyrgyz literature. Through his works, he deeply explored the human inner world, social, and spiritual life, bringing deep philosophical reflections into Kyrgyz literature. Tabyldy Mukanov (1929-1999) was a prominent figure in Kyrgyz poetry, a poet, and a writer who made significant contributions to Kyrgyz literature. In his poetry, he addressed deep reflections on the human inner world, spiritual searches, and the meaning of life. Mukanov's poetry of the 1970s and 1980s was particularly focused on social themes and the spiritual and moral state of humans.

T. Mukanov raised profound reflections on the human inner world, its place in society, spiritual growth, and the connection between humans and nature in his poetry. He shared many thoughts on human life and its views on itself. The theme of love is also widely reflected in Mukanov's works. However, he presented love as linked to a person's inner world, spiritual achievements, and social conditions. In his poetry, love is seen as one aspect of human spiritual maturity. Mukanov is one of the poets who connected nature with the human inner world. He depicted nature as an important element that helps in spiritual growth and understanding human feelings. In his poetry, the place and significance of both humans and nature are intertwined. Tabyldy Mukanov also addressed social and public themes in his poetry. He raised issues such as injustice, social problems, and the hardships in people's lives. Furthermore, he called on people to find light in the world, seek justice, and foster mutual understanding. Mukanov's works contain deep philosophical reflections on life, death, nature, and the human condition. He viewed death as a part of life, linking it to the past and future meanings of life. Tabyldy Mukanov's poetry of the 1970s and 1980s had a significant impact on Kyrgyz literature. Through his works, he provided a deep analysis of the human spiritual world and its social, moral, and spiritual issues, elevating Kyrgyz poetry to a new level.

Sagyn Akmatbekova is a well-known figure in Kyrgyz poetry, a poet who made a significant contribution to Kyrgyz culture and literature through her works.



In her poetry, she reflected on the human inner world, love, social problems, and the destinies of individuals. Akmatbekova played a major role in Kyrgyz poetry of the 1970s and 1980s, combining social and philosophical themes. In her poetry, Akmatbekova depicted the deep philosophy of love. Love appears in her works as an important aspect of a person's inner world, feelings, thoughts, and spiritual state. Nature in Akmatbekova's poetry is portrayed as an important space for exploring and deeply understanding the human soul.

Akmatbekova linked the elements of nature (stars, sky, earth, water) to the human soul, depicting their significance with poetic mastery. Her works contain deep reflections on life, its unforgettable impacts, and the goals of a person's life journey. Akmatbekova explored both the spiritual and physical states of humans, calling for an understanding of life's impermanence and its meaning. Through her poetry collections such as "Rain" (1970), "Distant Fields" (1972), "Moonlit Hill" (1978), "Light in the Window" (1984), "The Leaf of the Past Year" (1987), "The Song of the Twilight" (1998), and "Autumn Poems" (1990), she brought a unique touch to Kyrgyz poetry. Her stylistic mastery, thematic and ideological scope, and artistic methods make her one of the distinctive representatives of poetry. She also succeeded in blending the features of Western and Eastern poetry with Kyrgyz worldviews, showing innovation in her work. Akmatbekova enriched Kyrgyz poetry by incorporating fascinating elements of world poetry, giving her works a special significance.

In the 1970s and 1980s, Sagyn Akmatbekova raised social issues, social injustice, and questions regarding the place of humans in society in her works. She deeply analyzed the problems of all social classes in Kyrgyz society and critiqued public perceptions. Reflections on the impermanence of life, its meaning, and death were also widely depicted in her works. She spoke about the eternal limitation of death and the necessity of appreciating life's opportunities. Sagyn Akmatbekova's works of the 1970s and 1980s hold a special place in Kyrgyz poetry. Her poetry is dedicated to understanding the inner world of people, their social issues, and their place in the world. Through her profound reflections, she greatly influenced the development of Kyrgyz poetry.

In the Kyrgyz poetry of the 1970s and 1980s, artistic techniques such as symbolism, metaphor, and allegory were widely used, deepening the content of the works. Poets introduced new aesthetic values in their creativity by using metaphors and symbols when discussing social and philosophical issues.

Symbolism occupied a special place in the creativity of poets during this period. Through symbols, poets brought to life abstract thoughts and the deep issues within the human inner world that were beyond the boundaries of socialist norms. Metaphor, as a new form of creativity, allowed poets to depict social and spiritual themes in a symbolic manner. Poets used metaphors to reflect on the place of humans in the world, their struggles, and their inner lives.

Allegory was also an important technique, allowing poets to express social and political problems not directly, but through imagination and representation. These artistic techniques moved beyond the direct, optimistic form of socialist realism and laid the foundation for creative freedom.

Conclusion

Socialist realism had a profound influence on Kyrgyz poetry. Through this influence, poets adapted to the ideological demands of society, but at the same time, they struggled for creative freedom. As a result of these influences, poets sought new aesthetic forms and content in poetry, attempting to overcome the limitations of socialist realism.



Innovation in the works of poets led to the breaking free from the strict boundaries of socialist realism, directing poetry towards independent poetic explorations.

Poets of the 1970s and 1980s sought creative freedom, philosophical depth, and aesthetic renewal to overcome the restrictions of socialist realism. By using artistic techniques such as symbolism, metaphor, and allegory, they succeeded in breaking free from the constraints of socialist ideology. Poets expanded Kyrgyz poetry by employing new creative forms and worldviews, thereby increasing its aesthetic values.

Kyrgyz poetry overcame the limitations of socialist realism, strengthening the pursuit of creative freedom. Poets used new poetic techniques to present social and human issues from a fresh perspective. This process opened the way for the development of Kyrgyz poetry and allowed it to connect with world literature. The pursuit of creative freedom and the unique philosophical views of poets enriched the wealth and diversity of Kyrgyz poetry.

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THE PROTAGONIST'S TROUBLESOME CHILDHOOD, ABRUPT DIVORCE AND REJECTION: A STUDY OF ASHA BANDELE'S *SOMETHING LIKE BEAUTIFUL*

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Abstract

The exploration of Something Like Beautiful enables me to discover Asha Bandele's troublesome childhood, abrupt divorce and rejection viewed as the consequence of her dark skin color in the United States. Described as a victim of social injustices which constitute a great hindrance to her evolution in this great nation, Asha Bandele experiences different forms of inhuman treatments because of her blackness and parent's irresponsibility. These treatments finally push her to engage in nightmarish-romantic relationships. Her experience of divorce and depression portrayed in Something Like Beautiful intertwines with the true Bandele's episodes of life on the American soil. For, her daughter's love for her which enables her to overcome her depression after her divorce with Rashid, draws the reader back to the experience of the actual-historical Asha Bandele. This account is therefore what urges me to confess that Something Like Beautiful is a revisitation of the author's sequences of life in the white man's world.

Keywords: The United States, Blackness, Rejection, Divorce, Depression.

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ATTITUDE AND READINESS OF PRIMARY EDUCATION STUDIES STUDENTS TOWARDS MOBILE LEARNING IN NIGER STATE COLLEGE EDUCATION MINNA

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Abstract

The study investigated the attitude and readiness of primary education studies students towards mobile learning in Niger state college education Minna. The study adopted a descriptive survey design. The target population for this study was 1,320 Primary Education Studies Students. Three hundred and fifty students (350) were sampled for the study and questionnaire was used for collecting data. Three research questions guided the study. Descriptive statistics of mean and standard deviation were used to analyze the data. A grand mean of 2.50 was used for decision making. The reliability of the instrument was determined using Cronbach's alpha and 0.78, index was obtained. The findings of this study revealed that students have positive attitude and are ready to utilize mobile learning devices. Based on the findings and conclusion drawn, the following recommendations are made to improve the attitude and readiness of primary education studies students towards mobile learning. Academic and instructional activities should be delivered to students via mobile devices. Lecturers should be trained and adopt mobile teaching.

Keywords: Mobile Learning, Attitudes and Readiness.



INTEGRATION OF SMART BOARD IN MICRO-TEACHING FOR PRE SERVICE TEACHER IN NIGER STATE COLLEGE OF EDUCATION

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Abstract

The 21st century schools today, uses smart board to gain popularity and tap from the benefits of technology in order to meet up with the challenges of the modern world of teaching. This study explores the integration of smart board in micro teaching sessions to enhance pedagogical practices aimed at preparing future of educators at Niger State College of Education. The research focuses on the preservations of traditional teaching methodologies while incorporating technological advancement to empower teachers and improve learning outcomes. By exploring how smart boards can be effectively utilized in micro teaching. This research addresses the challenges faced by educators in adapting to modern teaching tools. This study also investigated the role of smart boards in promoting pre-service teachers engagement; the benefits of smart boards for teachers, using smart boards for improving motivation and retention in the learners. The review of previous studies revealed that smart boards are very innovative and powerful support for teaching and learning. Moreover, they increased learning process. Recommendation includes the provision of adequate training and support for pre-service teachers to minimize the benefits of smart board technology in teaching practice.

Keywords: Smart board, Micro-teaching, Pre-service teachers, Integration.



GÜNEYDOĞU ASYA VE DEĞIŞEN DÜNYA

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ÖZET

Güneydoğu Asya, son yıllarda küresel siyaset ve ekonomide önemli bir rol oynamaya devam etti. Bölge, tarihi boyunca farklı kültürler, dinler ve medeniyetler arasında bir köprü görevi görmüş ve stratejik konumu nedeniyle her zaman ilgi odağı olmuştur. Günümüzde hızla gelişen ekonomileri, dinamik sosyal yapıları ve bölgesel güvenlik sorunlarıyla dikkat çekmektedir.

Güneydoğu Asya'nın en belirgin özelliği, dünya ekonomisindeki artan etkisidir. Çin'in yükselişiyle birlikte bölgedeki ülkeler de küresel üretim zincirlerinde önemli bir yer edinmiştir. Endonezya, Tayland, Vietnam ve Filipinler gibi ülkeler, ucuz işgücü ve hızla gelişen altyapıları sayesinde büyük yatırımlar çekmektedir. Ayrıca bölgedeki güçlü üretim ve teknoloji sektörleri, dünya ticaretinde önemli oyuncular olmalarını sağlamaktadır.

Ancak bölge hala birçok iç ve dış sorunla karşı karşıyadır. Güneydoğu Asya'nın coğrafi olarak yakın ülkeleri, kültürel ve politik farklılıklar nedeniyle zaman zaman gerginlikler yaşamaktadır. Myanmar'daki askeri darbe ve Tayland'daki siyasi istikrarsızlık gibi örnekler, bölgenin politik olarak ne kadar kırılgan olduğunu göstermektedir. Ayrıca, Güney Çin Denizi üzerindeki iddialar, Çin'in bölgedeki artan etkisiyle daha da karmaşık hale geldi.

Ancak, Güneydoğu Asya ülkeleri dünya düzenindeki büyük değişikliklere uyum sağlıyor. Asya-Pasifik bölgesi küresel ticaret ve siyasetin merkezi haline geldikçe, bu ülkeler ekonomik ve politik olarak daha fazla etkileşim kurmaya devam ediyor. Güneydoğu Asya'nın geleceği, bölgedeki iş birliği ve dengelerin nasıl şekillendiğine bağlı olarak dünya çapında daha önemli hale gelecek.

Sonuç olarak, Güneydoğu Asya değişen dünya düzenini şekillendirmede önemli bir aktör olmaya devam ediyor ve bölgedeki gelişmeler küresel barış ve refahta kritik bir rol oynuyor.

Anahtar Kelimeler: Gelişim, ortak değerler, değişim, ortak gelecek, eğitim

SOUTHEAST ASIA AND THE CHANGING WORLD

ABSTRACT

Southeast Asia has continued to play an important role in global politics and economics in recent years. Throughout its history, the region has served as a bridge between different cultures, religions and civilizations and has always been a center of attention due to its strategic location. Today, it attracts attention with its rapidly developing economies, dynamic social structures and regional security issues.

The most distinctive feature of Southeast Asia is its increasing influence in the world economy. With the rise of China, countries in the region have also gained an important place in global production chains. Countries such as Indonesia, Thailand, Vietnam and the Philippines attract large investments thanks to their cheap labor and rapidly developing infrastructure. In addition, the strong manufacturing and technology sectors in the region allow them to be important players in world trade.



However, the region still faces many internal and external problems. The geographically close countries of Southeast Asia experience tensions from time to time due to cultural and political differences. Examples such as the military coup in Myanmar and the political instability in Thailand show how politically fragile the region is. In addition, claims over the South China Sea have become even more complicated with China's growing influence in the region.

However, Southeast Asian countries are adapting to major changes in the world order. As the Asia-Pacific region becomes the center of global trade and politics, these countries continue to interact more economically and politically. The future of Southeast Asia will become more important worldwide depending on how cooperation and balances shape the region.

As a result, Southeast Asia continues to be a major player in shaping the changing world order, and developments in the region play a critical role in global peace and prosperity.

Keywords: Modern South Asia, values, challenges, perspective, education

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POPULATION AGEING AND EXTERNAL DEBT: THE CASE OF EMERGING AND DEVELOPING ECONOMIES

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Abstract

While the population is aging rapidly in developed countries, significant increases in the elderly population are also observed in developing countries. The increase in the elderly population may lead to a number of macroeconomic problems for countries. The aim of this study is to investigate the impact of population ageing on external debt for emerging and developing countries. The study covers the period 1996-2019 and the system-generalised method of moments (GMM) is used. The findings show that population ageing has a positive effect on external debt. This result supports the hypothesis that the high expenditures of the elderly population such as health and pensions will deepen the budget deficit and increase external borrowing. Therefore, an increase in external debt due to population ageing can be expected in developing and emerging economies. It was also determined that economic growth decreases external borrowing. International reserves has a positive impact at 10% significance level. As a result, it can be said that the authorities should accelarate economic growth in order to reduce the need for external borrowing and implement policies to mitigate the effect of population ageing on government expenditures.

Keywords: External debt, population ageing, developing countries

Introduction

The world population is ageing rapidly. According to the estimates of the United Nations, the ratio of the population over the age of 65 to the total population, which was 9% in 2019, is expected to double to 16% in 2050 (Pena, 2020: 1). The ageing of the population can be caused by two different mechanisms. The first of these is increasing life expectancy, while the second is declining fertility rates. Declining fertility rate is one of the most important factors triggering population ageing. As a result of decreasing birth rates, the young population decreases and this increases the proportion of the elderly population (Afflatet, 2018: 68; Yang, Norton and Stearns, 2003: 2). While there were high birth and death rates before the industrial society, low birth and death rates were observed after industrialisation. Especially the decline in infant and child mortality rates constituted the first stage of demographic change. In the next stage, birth rates also decreased (Bloom and Jeffrey, 1997: 5). As a result, it was observed that the population was ageing, especially in developed countries.

Budget deficit is one of the most important macroeconomic adverse effects of population ageing.



The effect of population ageing on the public budget deficit may firstly be realised as an increase in government expenditures and income transfers in areas such as health, pension, etc. that the elderly will need. Secondly, an population ageing may lead to a decrease in government expenditures on education and child support. Thus, we can talk about two opposite effects of population ageing on government expenditures. However, it is stated that the decrease in government expenditures such as education for children etc. due to the population ageing is limited or uncertain. Therefore, the literature largely emphasises that ageing will trigger the budget deficit. The increase in public expenditures by the elderly population is mainly due to health payments. It is known that older people are more susceptible to diseases and struggle with costly chronic diseases that require more frequent medical intervention. On the other hand, population ageing also leads to an increase in public expenditures through pension expenditures. The social security system is largely based on a system in which expenditures on pensioners are financed simultaneously by taxes collected from employees. Since the population ageing will increase the number of retirees, the number of beneficiaries of the public pension system increases with the population ageing, while the number of employeed people who contribute decreases (Cho and Kim, 2021; Jensen and Nielsen, 1995). As a result, increasing health, pension, etc. expenditures with the population ageing lead to a deterioration in the budget deficit. It is argued that this increase in government expenditures may eventually lead to a slowdown in economic growth (Alonso-Garcia and Rosado-Cebrian, 2021: 202). Because expenditures such as pensions and health expenditures are largely related to current expenditures, and the transfer of government resources to these fields reduces these resources to be transferred to investment (Rahman, Ismail and Ridzuan, 2021: 412).

The population ageing may also have a negative impact on the labour market and savings. An increase in the elderly population and a decline in birth rates would imply a decrease in the labour force. This will lead to a decrease in the number of people financing the dependent elderly population, thus increasing the tax burden on employees. In this case, public saving may decrease (Bloom and Jeffrey, 1997: 10; Kim and Lee, 2008: 244).

The approach arguing that savings will decrease as a result of ageing can be based on the life cycle hypothesis developed by Modigliani and Brumberg (1954). According to this hypothesis, there are 3 important periods in the life span of individuals. The first of these periods is the childhood period before working age and covers the years when consumption exceeds income. Therefore, savings are negative in childhood. In the second stage, individuals between the ages of 15-65 are in the labour force and income exceeds consumption. Thus, there is positive saving. The retirement years are the years when income decreases and therefore negative savings are realised again. In short, considering the life cycle hypothesis, it can be concluded that the increase in the child and elderly population (dependency ratio) will negatively affect savings. Declining savings will lead to the problem of not being able to obtain the funds needed for investments and R&D expenditures. In addition to the decline in savings and thus the capital stock, the low ability of the elderly to adapt to innovations and technology will lead to a decline in productivity and production. On the other hand, contrary to the life cycle hypothesis, elderly people may have a higher propensity to save. This is justified by the savings made with discretionary motives due to uncertainty. Uncertainty about the timing of retirement and death may have a major impact on the saving rate of the elderly.



The motive to leave an inheritance to the children left behind is also shown as another factor that prevents the decline in saving in old age (Goh, Mcnown and Wong, 2020: 5; Kim and Lee, 2008: 243; Ramos-Herrera and Sosvilla-Rivero, 2020: 2). Similarly, it is stated that population ageing may be limited to cause problems in the labour market by reducing labour supply. According to this approach, capital replacing labour in the industry with artificial intelligence, robots and machine learning as a result of technological developments will reduce the dependence on labour (Rahman, Ismail and Ridzuan, 2021:410).

In addition to the effect of population ageing on budget deficit and savings, it also increases public debt and external debt. The effect of population ageing on debt results from the search for resources that emerges as a result of the increase in public expenditure and budget deficit due to ageing. The factors leading to public debt can generally be summarised as the need for funds. If the state can obtain sufficient funds from taxes, government expenditures can be financed with these funds. However, there may not be sufficient resources (labour force) to cover the cost of the population ageing. In addition, while health expenditures and pension expenditures increase due to ageing, budget deficits and thus public debt are expected to increase if there is no change in tax policies (Lee, Mason and Park, 2022: 342). On the grounds that taxation negatively affects economic growth and purchasing power, the government generally does not prefer taxation. For this reason, the additional expenditures caused by the increase in the elderly population are generally met through external borrowing (Rahman, Ismail and Ridzuan, 2021:410). Therefore, since the elderly population in developed and developing countries is expected to increase further in the future, public debt is expected to increase in parallel. However, the amount of public debt in the future is somewhat uncertain. Because it is not known exactly in which direction the policies regarding taxes and government expenditures will change (Goedl and Zwick, 2018: 560; Lee, Mason and Park, 2022: 342). In this context, determining the extent to which population ageing affects debts may be instructive in terms of the policies that can be implemented. When a fiscal policy that will generate sufficient revenue for the budget deficit and increasing debts is not implemented, debts may reach a level that cannot be paid (Mensah, Aboagye, Abor & Kyereboah-Coleman, 2017: 434; Ramos-Herrera & Sosvilla-Rivero, 2020: 3).

The aging of the population is a problem faced especially by industrialised countries. However, although population ageing is mostly perceived as a problem of developed countries, it is thought to be an important threat for developing countries as well. Because, although the young population is high in lower and middle income countries, it is observed that the population in these countries has started to age (Lee, Mason and Park, 2022: 342; Yang, Norton and Stearns, 2003: 2). According to the prediction of the United Nations, the increase in the elderly population will turn against developing countries and by 2050, approximately 80% of the elderly population will be found in lower and middle income group countries (Pena, 2020: 1). As a result, considering that the elderly population will increase further in both developed and developing countries in the future, it will be important to implement effective policies that take into account the change in demographic structure for a sustainable external debt (Jensen and Nielsen, 1995: 2). This is because it is known that raising tax rates will have a distortive effect by causing welfare loss. By reducing government expenditures in other areas, the state will be able to minimise the negative impact of the elderly population on external debt by alleviating the deficit in the government budget(Afflatet, 2018: 69). Therefore, this study investigates the possible impact of population ageing on external debt for emerging and developing economies.



The fact that there are few studies investigating the direct impact of population ageing on external debt and that the existing studies have not reached a common conclusion is another factor motivating the conduct of this study.

Literature Review

In the literature, there are various studies investigating the effect of ageing on budget deficit. These studies have largely found that public expenditures or budget deficits increase with the ageing of the population. For example, Ramos-Herrera and Sosvilla-Rivero (2020) analysed the 1980-2019 time period for 11 European countries. As a result of the analyses based on panel fixed effect, random effect and pooled OLS methods, the author determined that the increase in the elderly population negatively affects fiscal sustainability. Alonso-Garcia and Rosado-Cebrian (2021), Goh, Mcnown and Wong (2020), Pena (2020), Cho and Kim (2021), Balçık, Konca and Biçer (2021) are among other studies that find that population ageing has a negative impact on the budget deficit. Among these, Cho and Kim (2021) conducted an analysis for the Korean economy, one of the fastest aging countries in the world, where life expectancy is increasing while marriage and birth rates are decreasing. Cho and Kim (2021) determined with projections that social expenditures for the elderly population will affect the budget and lead to a decrease in tax revenues. Similarly, Balçık, Konca and Biçer (2021) and Goh, Mcnown and Wong (2020) found that the increase in the elderly population causes an increase in government expenditure and budget deficit as expected in theory for OECD countries and Japan, respectively. Analysing the Spanish economy, Alonso-Garcia and Rosado-Cebrian (2021) emphasised that the solution to this situation is to increase labour force participation and new reforms in pension issues. According to Pena (2020), when policies that increase government revenues and reduce government expenditures are implemented, budget deficits arising from the elderly population can be financed to a significant extent.

There are very few studies that directly address the relationship between ageing and debt. Among these, Afflatet (2018) examined 18 EU countries and analysed the 1980-2015 period. At the end of the study, the author found weak evidence of the effect of the elderly population on public debt. Rahman, Ismail and Ridzuan (2021) analysed the data of upper-middle-income countries covering the period 2000-2017. Rahman, Ismail and Ridzuan (2021) modelled 36 countries and found that the population over the age of 65 increased external debt. This is explained by the increase in the elderly population, which increases government expenditures such as elderly-friendly infrastructure, health and pensions. However, in the same study, when the elderly dependency ratio variable was used to represent the elderly population, it was observed that the coefficient was statistically insignificant. According to the author, the increase in the long-term savings of the elderly population leads to this result. In another study, Kamiguchia and Tamai (2019) for the UK, Germany and Japan, and Pan and Wang (2012) for the Euro area found that the elderly population has an increasing effect on public debt. On the other hand, Mulugeta (2021) found that the effect of the elderly dependency ratio on external debt is insignificant and positive in Ethiopia.

Data and Model

In this study, it is aimed to test the approach that population ageing, which emerged with the change in demographic structure, will increase the pressure on external debt as it will worsen the public budget.



For this purpose, an analysis was carried out for emerging and developing countries according to the IMF classification. In the study, 38^1 countries were analysed. Data covering the period 1996-2019 are taken from the World Bank database (WDI,2023).

The variables in the model are determined by evaluating the existing literature. There are studies that identify trade openness (e.g., Awan, Anjum and Rahim (2015), Osuji and Olowolayemo (1998) and Colombo and Longoni (2009)), government expenditure or budget deficit (e.g., Waheed (2017), Awan, Anjum and Rahim (2015) and Loganathan, Sukemi and Sanusi(2010)) as factors that increase external debt. Lau, Lee and Arip (2015), Chiminya and Nicolaidou (2015) and Waheed (2017) are examples of studies that include international reserves in the model and find a negative relationship. Among the studies investigating the effect of economic growth on external debt, Bittencourt (2015) found that economic growth reduces external debt for South America. Nguyen (2018) and Arslan and Athwari (2019) are also among the studies that observe that economic growth is significant in affecting external debt.

The model used in the study is as follows; $debt_{it} = \beta_1 debt_{it-1} + \beta_2 g dp_{it} + \beta_3 old s_{it} + \beta_4 rezerv_{it} + \beta_5 open_{it} + e_t$ (1)

 $debt_{it}$; which is the dependent variable in the model in Equation 1, represents external debt. The ratio of external debt to GDP is used to represent external debt. Among the explanatory variables in Equation 1, gdp_{it} , $rezerv_{it}$, and $open_{it}$ represent economic growth, international reserves and trade openness, respectively. Economic growth may affect external debt negatively or positively. Since the income of the public sector increases with economic growth, the need for external debt decreases. On the other hand, economic growth will have a positive impact on the economic outlook of the country by raising its credit rating. In this case, it may be possible for the country to borrow easily from foreign markets (Waheed and Abbas, 2021: 6). In this study, GDP per capita is included in the model as an indicator of economic growth.

The ratio of exports and imports to GDP is used as an indicator of openness. This variable will also reflect the country's total international trade with other countries. Since openness is expected to positively affect economic development and economic growth by increasing productivity, it is expected to negatively affect external debt (Mahara and Dhakal,2020: 280). However, it is also possible for openness to increase external debt. This can be explained by easier access to international markets.

The effect of international reserves, on external debt is also uncertain. An increase in reserves may negatively affect external debt by reducing the need for external debt. On the other hand, high reserve ratios may facilitate external borrowing as they are perceived as a guarantee that the country will be able to repay external debts. Therefore, it is also possible that reserves can positively affect external debt (Waheed and Abbas, 2021: 6).

¹ Ukraine, Algeria, Brazil, China, Colombia, India, Indonesia, Armenia, Belize, Bangladesh, Belarus, Bolivia, Botswana, Costa Rica, Egypt, Ecuador, Dominican Republic, Fiji, Gabon, Honduras, Ghana, Jamaica, Kazakhstan, Kyrgyzstan, Kenya, Mairitus, Moldova, Mexico, Morocco, Nigeria, Nepal, Paraguay, Peru, Philippines, South Africa, Thailand, Türkiye.



debt _{it-1}; denotes the lagged value of the dependent variable. Since it is known that economic variables depend on their past values, studies on external borrowing generally include the lagged value. As stated by Mijiyawa and Oloufade (2022: 13), the inclusion of the lagged value of external borrowing in the model indicates that if a country resorted to external borrowing for purposes such as energy, education, infrastructure investments and defence in the past, it will borrow again for similar needs in the future old_{it} represents the ratio of elderly population to the total population. As explained in the theory, the coefficient of old_{it} should be positive.

Empirical Findings

In the study, the system-GMM (Generalised Method of Moments Estimator) method was used to estimate the Model 1 which was constructed to determine the possible effect of population aging on external debt. However, in order to determine whether the series contain a unit root or not, a unit root test was performed first. ADF Fisher test proposed by Choi (2001) and based on Fisher (1932) test, IPS test developed by Im et. al (2003) and LLC test developed by Levin et. al (2002) were applied. The results obtained from these tests are summarised in Table 1. According to the results here, it can be concluded that while the external debt has unit root at the level, economic growth, openness, ageing and international reserves are stationary at the level.

			debt	gdp	open	reserv	old
LLC	intercept		-3.2308	-12.4047	-2.2954	-4.4557	-1.2034
	-		(0.0006)	(0.0000)	(0.0109)	(0.000)	(0.1144)
	intercept	and	-1.7663	-1.)7663	-3.9257	-4.6097	-11.7873
	trend		(0.0387)	(0.0387)	(0.0000)	(0.000)	(0.0000)
ADF	intercept		0.9107	18.0442	1.7440	1.4773	15.0216
Fisher	-		(0.1812)	(0.0000)	(0.0406)	(0.0698)	(0.000)
	intercept	and	-1.6377	13.6656	7.0476	4.1562	20.7853
	trend		(0.9493)	(0.0000)	(0.0000)	(0.000)	(0.0000)
IPS	intercept		-0.6002	-12.8046	-1.2048	-3.1125	2.6831
			(0.2742)	(0.000)	(0.1141)	(0.0009)	(0.9964)
	intercept	and	1.5505	-11.4367	-2.0513	-2.8446	-7.5549
	trend		(0.9395)	(0.000)	(0.0201)	(0.0022)	(0.0000)
First							
difference							
	intercept		-17.8650	-30.5917	-20.7385	-21.8023	-4.8520
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LLC	intercept	and	-14.8903	-28.2239	-18.1115	-19.7703	-6.5287
	trend		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ADF	intercept		16.8860	68.7405	31.8909	35.8366	5.2764
Fisher	_		(0.000)	(0.000)	(0.0000)	(0.000)	(0.000)
	intercept	and	13.2297	54.1292	26.6100	27.8489	5.2941
	trend		(0.000)	(0.000)	(0.000)	(0.000)	(0.0000)
IPS	intercept		-16.1515	-30.3406	-20.0201	-21.7714	-2.0761
			(0.000)	(0.000)	(0.000)	(0.000)	(0.0189)

Table 1. Results of Unit Root Tests



System-GMM approach, which is one of the dynamic panel data methods, was introduced to the literature by Arellano and Bover (1995) and Blundell and Bond (1998). In this study, a two- stage estimation method is used and the robust standard errors method developed by Windmeijer (2005) is used as a robust estimator.

	Coeff.	Std.error	z-stat.	Prob.
debt(-1)	.4030961	.1197455	3.37	0.001
gdp	0077074	.0013768	-5.60	0.000
old	.0487201	.0151514	3.22	0.001
rezerv	.0188296	.0101544	1.85	0.064
open	.0024961	.0067482	0.37	0.711
AR(1)	-3.03(
	0.002)			
AR(2)	1.50(0.133)			
Hansen:	3.93(0.686)			
DiferenceHansen:	3.55(0.471)			
obs	836			
Cross section	38			
Number of	11			
instruments				

Tablo 2. Results of System-GMM Approach

The results obtained from the two-stage system-GMM estimation are shown in Table 2. According to Table 2, the impact of the elderly population on external debt is positive. While these findings differ from those of Mulugeta (2021), they are consistent with the findings of Rahman, Ismail and Ridzuan (2021), Kamiguchia and Tamai (2019), and Pan and Wang (2012). The lagged value of external debt, has a positive and significant impact as expected.

The effect of international reserves on external debt is also positive and significant at the 10% significance level. In this case, it can be said that international reserves are seen as an assurance that the country can repay external debts and facilitate external borrowing. The factor that contributes to the reduction in external debt is economic growth. Since government revenues will increase with economic growth, the need for external financing will decrease.

The increase in foreign trade has no effect on external debt. This situation is inconsistent with the approach that economic growth will be positively affected as openness to foreign trade increases in developing countries and thus external debt will decrease.

The diagnostic test results in Table 2 show that the validity of the model is ensured. According to the AR(2) test results, there is no second order autocorrelation in the model. In addition, since the probability value of the Hansen test is greater than 0.25, the main hypothesis stating that over- identification restrictions are valid cannot be rejected. In other words, the instrumental variables used are robust and valid. The results of the difference Hansen test indicate that the null hypothesis that the instrumental variable set is exogenous cannot be rejected. In addition, it is also observed that the number of instrumental variables is smaller than the number of units as desired.

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Conclusion

In this study, it is aimed to analyse the population ageing-external debt relationship. Developing and emerging countries are considered and analysed with the system-GMM method. The results of the analysis covering the 1996-2019 time period show that population aging has a positive effect on external debt, while economic growth reduces external debt. The effect of trade openness on external debt is positive but statistically insignificant. International reserves have a positive effect on external debt at the 10% significance level.

According to these results, it can be said that the authorities should pay attention to economic growth in order to reduce external debt. With economic growth, both tax revenues will increase and favourable developments will be observed in the capital stock and foreign direct investments in the country. On the other hand, it should be aimed to increase production by transferring the funds obtained from external debt to sectors with high productivity. Thus, external debts can be reduced through economic growth and repayment obligations can be facilitated.

The positive effect of the increase in the elderly population on external borrowing implies that, the expenses of the elderly population such as health, retirement, etc. will trigger external borrowing by increasing public expenditures. This situation does not confirm Rahman, Ismail and Ridzuan's (2021: 418) argument that since the elderly in these countries usually live with their children, the burdens brought by the elderly population are borne by their children and therefore the state does not have to resort to external borrowing. Considering that the portion of the elderly will increase further in developing and emerging economies in the future, the authorities need to pursue an effective fiscal policy. In this context, different options can be considered instead of external borrowing to finance public expenditures arising from expenditures on the elderly population. For example, tax policies can be reformed. In addition, individuals may be encouraged to save more by thinking about their old age. Thus, the burden on the state can be eased.

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TÜRKİYE'DEKİ DÖVİZ KURU VE ENFLASYON ARASINDAKİ İLİŞKİ

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Özet

Döviz kurlarında istikrarsızlık ve enflasyon Türkiye'de son dönemde önemli ekonomik ve sosyal sorunlar arasında yer almaktadır. Bu değişkenler arasında teorik ve empirik literatüre göre, güçlü bir ilişki bulunmaktadır. Bundan dolayı bu çalışmada, son yıllarda Türkiye'de döviz kuru ve tüketici fiyat endeksi (TÜFE) arasındaki uzun ve kısa vadeli ilişkinin incelenmesi hedeflenmektedir. Döviz kuru (ABD doları karşısında TL kuru) ile TÜFE arasındaki ilişki 2020:01-2024:11 dönemi aylık verileri kullanılarak çeşitli yöntemlerle incelenmiştir. Analizde ADF (Augmented Dickey-Fuller) Durağanlık Testi, Johansen, ARDL (Autoregressive Distributed Lag) ve Engle-Granger Eşbütünleşme Testleri kapsamında değişkenler arasındaki ilişkiler değerlendirilmiştir. Bu testler, ekonomi literatüründe sıklıkla kullanılan ve ekonomik değişkenler arasındaki uzun vadeli ve kısa vadeli etkileşimleri analiz etme açısından önemli araçlardır. Elde edilen bulgular, TÜFE ve döviz kuru arasında uzun vadeli eşbütünleşme ilişkisinin olduğunu göstermekte, yani bu iki değişkenin uzun vadede birlikte hareket ettiği sonucuna varılmaktadır. Esbütünlesme testleri, TÜFE'nin gecmis değerlerinin döviz kurunu tahmin etmede anlamlı bir Granger etkisi olduğunu, ancak döviz kurunun TÜFE üzerinde bir etkisi olmadığını ortaya koymaktadır. Sonuç olarak, çalışmanın bulguları, enflasyonun döviz kuru üzerindeki etkisini vurgulamakta ve ekonomik politika yapıcılarına, ekonometrik analizler üzerine dayanan daha bilinçli ve etkili kararlar alabilmeleri için önemli çıkarımlar sunmaktadır.

Anahtar Kelimeler: Döviz Kuru, TÜFE, Enflasyon, Zaman Serileri Analizi, Eşbütünleşme ilişkisi

THE RELATIONSHIP BETWEEN THE EXCHANGE RATE AND INFLATION IN TÜRKIYE

Abstract

Exchange rate instability and inflation have been among the major economic and social problems in Turkey in recent years. According to theoretical and empirical literature, there is a strong relationship between these variables. Therefore, this study aims to analyze the short-run and long-run relationship between exchange rate and Consumer Price Index (CPI) in Turkey in recent years. The relationship between exchange rate (TL exchange rate against US dollar) and CPI is analyzed using monthly data for the period 2020:01-2024:11 using different methods. In the analysis, the relationships between variables are evaluated within the framework of ADF (Augmented Dickey-Fuller) stationarity test, Johansen, ARDL (Autoregressive Distributed Lag) and Engle-Granger cointegration tests. These tests are widely used in economic literature and are important tools for analyzing long-run and short-run interactions between economic variables.



The results indicate that there is a long-run cointegration relationship between the CPI and the exchange rate, which means that these two variables move together in the long run. The cointegration tests show that past values of the CPI have a significant Granger effect in predicting the exchange rate, but the exchange rate has no effect on the CPI. In conclusion, the results of the study highlight the impact of inflation on the exchange rate and provide important implications for economic policy makers to make more informed and effective decisions based on econometric analysis.

Keywords: Exchange Rate, CPI, Inflation, Time Series Analysis, Cointegration Relationship

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THE EVOLUTION OF INTERNATIONAL INVESTMENTS INTO THE ASIAN TIGERS CRISIS

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ABSTRACT

Throughout the 1980s and 1990s, countries known as the Asian Tigers-South Korea, Taiwan, Hong Kong, Singapore, Malaysia, Indonesia, Japan and Thailand-drew attention with their rapid economic growth, export-oriented industrialisation, and foreign investments. However, the 1997 Asian Financial Crisis disrupted this success story, demonstrating how international investments could evolve into a crisis. During the growth process, these countries became heavily dependent on international capital. In particular, short-term external borrowing and speculative investments increased financial vulnerability. The crisis began in Thailand when the local currency, the baht, depreciated significantly. This led to investor panic, causing the crisis to spread to other countries in the region. Investors rapidly withdrew their capital, collapsing financial systems and leading to major bankruptcies in the banking sector. International organisations intervened with strict fiscal policies and reforms to mitigate the crisis's impact. However, the crisis resulted in severe economic contractions and social turmoil in the region. The Asian Tigers Crisis highlighted how the uncontrolled flow of capital could pose a significant threat to fragile financial systems, emphasizing the need for a more cautious approach to international investment policies. This study examines the necessity of balanced capital movement management in the global financial system and the risks of speculative investments to prevent similar crises in the future. Additionally, it evaluates the impact of international interventions during the crisis and discusses potential measures to prevent future financial crises. .

Keywords: Financial system, international markets, Asian Tigers.

ASYA KAPLANLARI KRİZİNE ULUSLARARASI YATIRIMLARIN EVRİMİ

ÖZET

1980'ler ve 1990'lar boyunca Güney Kore, Tayvan, Hong Kong, Singapur, Malezya, Endonezya, Japonya ve Tayland gibi Asya Kaplanları olarak adlandırılan ülkeler, hızlı ekonomik büyüme, ihracata dayalı sanayileşme ve yabancı yatırımlarla dikkat çekti. Ancak 1997'de başlayan Asya Finans Krizi, bu başarı hikâyesini sarsarak uluslararası yatırımların nasıl bir krize evirilebileceğini gösterdi. Büyüme sürecinde bu ülkeler, büyük ölçüde uluslararası sermayeye bağımlı hale geldi. Özellikle kısa vadeli dış borçlanmalar ve spekülatif yatırımlar, finansal kırılganlığı artırdı. Tayland'da yerel para birimi bahtın aşırı değer kaybetmesiyle başlayan kriz, yatırımcıların paniğe kapılmasıyla diğer bölge ülkelerine yayıldı. Yatırımcılar, sermayelerini hızla çekerek finansal sistemleri çökertti ve bankacılık sektöründe büyük iflaslara yol açtı. Uluslararası kuruluşların müdahaleleri, sıkı mali politikalar ve reformlarla krizin etkilerini hafifletmeye çalıştı. Ancak kriz, bölge ekonomilerinde büyük küçülmelere ve sosyal çalkantılara neden oldu.



Asya Kaplanları Krizi, sermaye hareketlerinin kontrolsüz şekilde yönlendirilmesinin, kırılgan finansal sistemler için nasıl bir tehdit oluşturduğunu ortaya koyarak uluslararası yatırım politikalarının daha temkinli ele alınmasına yol açtı. Bu çalışmada; küresel finansal sistemde sermaye hareketlerinin dengeli yönetiminin gerekliliği ve spekülatif yatırımların riskleri gibi konular ele alınarak, gelecekte benzer krizlerin önüne geçilebilmesi için önlemleri belirlenmektedir. Bununla birlikte çalışmada, kriz sürecinde uluslararası kuruluşların müdahalelerinin etkileri değerlendirilerek, benzer krizlerin önlenmesi için alınabilecek tedbirler tartışılmaktadır.

Anahtar kelimeler: Finansal sistem, uluslararası piyasalar, Asya Kaplanları.

INTRODUCTION

International investments are one of the key dynamics of the global economy, playing a decisive role in areas such as capital flow, technology transfer, and economic development. However, these investments can sometimes lead to economic instability and crises in host countries. The 1997 Asian Financial Crisis is one of the most striking examples that demonstrates how international capital flows and investment movements can affect the delicate balances of an economy.

The so-called "Asian Tigers," including countries such as South Korea, Thailand, Malaysia, Indonesia, and the Philippines, attracted attention with their rapidly growing economies starting from the 1980s. Through foreign investments and export-oriented policies, they rose to a significant position in the global economy. However, in 1997, these countries faced a major financial crisis that shook the entire Regional Economic Development Model.

This crisis highlighted the dual effects of international investment flows and short-term capital movements, revealing the vulnerabilities of financial systems in emerging markets. This study aims to examine the impact of international investments on the Asian Financial Crisis, evaluating the policies followed before and after the crisis and the role of international capital movements Keskin, 2024a).

In this context, the study will explore the economic structure prevailing in the Asian Tigers before the crisis, the changes in international investments during the crisis, and the long-term effects of the crisis. The results of the study aim to provide recommendations on which policies should be adopted to understand the potential risks of international investments for emerging markets and to prevent crises.

THEORETICAL FRAMEWORK ASIAN TIGER CRISIS

Among the developing economies of Southeast Asia, Thailand, Malaysia, Indonesia, the Philippines, and South Korea experienced rapid and remarkable economic growth starting in the mid-1980s. However, the Asian financial crisis of 1997 interrupted this growth process and led to economic instability. The Kingdom of Thailand, located on the southeastern coast of Asia along the Gulf of Thailand and the Andaman Sea, shares borders with Myanmar to the west, Laos to the north and east, and Cambodia to the southeast. Historically known as "Siam," the country changed its name to "Thailand," meaning "Land of the Free," to emphasize its distinction as never having been colonized by Western European powers. With a population of approximately 60 million, Thailand is ethnically diverse, with about 80% of the population being of Thai descent, 12% Chinese, and 4% Malay. The official language is Thai, but English is widely used in business. The capital, Bangkok, is the country's economic and cultural hub.



Thailand transitioned to a planned economic development model in 1961 and began implementing five-year development plans, which is similar to the establishment of the State Planning Organization in Turkey in the same year. Thailand's eighth development plan is still in effect, and the agricultural sector plays a significant role in the country's economy, contributing more than 11% to the Gross National Product (GNP). The country's staple food is rice, and rubber is one of the most important export products.

Another Southeast Asian economy, Malaysia, is a federation formed by the union of the Malay Peninsula or the Malay Archipelago with the northern coast of Borneo, comprising the Sabah and Sarawak regions. Despite its official religion being Islam, Malaysian society is ethnically and culturally diverse. The population includes Malays, Chinese, Indian-Pakistani descendants, and various indigenous tribes. A significant portion of the Chinese and Indian communities have not embraced Islam. Malaysia remained under British colonial rule until 1957, although the region has historically been under the control of various powers such as Portugal, the Netherlands, France, and Japan. While the political structure is predominantly controlled by the Malay population, the economy and trade are largely in the hands of the Chinese minority. There have been significant social and economic conflicts between these two ethnic groups throughout history. Kuala Lumpur is the capital of Malaysia.

Indonesia, another major economy in Southeast Asia, is one of the most striking countries in the region due to its geographical diversity and historical background. Spread across the Indian and Pacific Oceans, Indonesia consists of more than 13,000, some sources say even over 17,000, islands. The largest islands include Sumatra, Kalimantan, Sulawesi, Irian Jaya, and Java. The Indonesian people can trace their history back to the 1st century AD, during which time the islands were invaded by Indian kingdoms. Hinduism is one of the five officially recognized religions in the country, and Buddhism arrived in Indonesia around the 5th century AD. Islam was accepted in 1297 and became the dominant religion.

Today, approximately 85% of Indonesia's population adheres to Islam. Like Malaysia, Indonesia was also heavily influenced by European colonialism for a long time. The first Europeans to reach the region were the Portuguese, who introduced Catholicism. Subsequently, the Dutch arrived and spread Protestantism, and in the early 17th century, the British and French reached Indonesia in 1769. The colonial powers constantly fought with both the local populations and each other, and ultimately, from the early 19th century until the end of World War II, the region remained under Dutch control.

Throughout the 19th century, the Netherlands reaped significant economic benefits from Indonesia, with revenue from coffee, tobacco, and oil, among other key products, accounting for approximately 30% of the country's budget in the 1850s. The income from these products helped finance the industrialization of the Netherlands, which, in turn, shaped the economy of Indonesia within the framework of colonial policies.

Independence movements in Indonesia began in the 1910s with the reformist Sarekat Islam movement. By 1919, the Sarekat Islam had reached two million members. The Islamic movement also received support from left-wing groups, and during this time, Sukarno emerged as one of the leading figures of Sarekat Islam. Sukarno advocated the idea of "Islamic Communism" and argued that historical materialism did not necessarily lead to atheism. In 1928, he founded the Nationalist Party (Partai Nasional Indonesia - PNI) to organize the independence struggle and adopted a policy of rejecting collaboration with the colonial government.



In 1942, Indonesia was occupied by Japan, and during this period, Sukarno increased his political influence as the first true national leader of the country. After Indonesia officially gained independence in 1950, Sukarno served as the country's president until he was removed by General Suharto in 1966. In 1966, Sukarno was forced to resign due to his close ties with the Indonesian Communist Party (PKI). The PKI, with around two million registered members and affiliated organizations, had a total membership of approximately nine million and was the largest communist party operating in a non-communist country. The party was closely allied with the People's Republic of China, and by 1964, it was believed to have amassed enough power to seize control of the country. In 1966, an uprising led by the PKI began in the capital Jakarta, resulting in the deaths of six out of seven generals known for their anti-communist views. The only surviving general, Suharto, played a crucial role in suppressing the coup. After the event, it was claimed that Sukarno was directly involved in the attempted coup, leading to the initiation of a large-scale anti-communist operation under Suharto's leadership. During this period, hundreds of thousands of people lost their lives. Some sources suggest that right-wing elements of Suharto were behind the generals' deaths and that the event was supported by the CIA. About a year later, Sukarno was forced to step down, and Suharto took over. Suharto remained in power until the 1997 Asian Financial Crisis.

South Korea is located on a peninsula in Northeast Asia, comparable in size to Great Britain. Although it has a long history, its emergence as a modern nation-state dates back to 1945, when the United States and the Soviet Union divided the country into North and South Korea. South Korea was declared a democratic republic in 1948, and that same year, Syngman Rhee, a Harvard University graduate, was elected as the country's first president.

Rhee was known for his authoritarian leadership, and one of his primary goals was to eliminate leftist groups supported by North Korea. In 1950, during the Korean War, South Korea suffered significant losses, but in the later stages of the war, North Korean forces were repelled. After the war, Rhee implemented the National Security Act, which turned the political system into a de facto dictatorship.

The electoral fraud in the 1960 elections led to mass protests, forcing Syngman Rhee to resign. Chang Myon temporarily assumed the presidency but was ousted three months later by a military coup. In the subsequent elections, General Park Chung-hee was elected president and played a significant role in South Korea's economic development. In 1965, he signed an agreement with Japan to secure economic aid in exchange for war reparations, which resulted in a substantial amount of Japanese capital flowing into South Korea.

However, Park's authoritarian rule gradually increased, and political pressures, particularly among student groups, led to major protests. Similar to the Syngman Rhee era, the government's repressive policies triggered large-scale protests in Seoul, prompting a strong response from the government. In 1972, Park Chung-hee declared martial law to control the opposition and strengthen his authority.

In 1972, South Korean President Park Chung-hee enacted a new constitution that significantly restricted individual rights and freedoms. This constitution granted the government broad powers and suppressed opposition. Paradoxically, it was during this period that South Korea experienced its most significant economic leap. Under Park's administration, an exportoriented growth strategy was adopted, and South Korean brands successfully established a lasting presence in international markets. However, despite the prosperity brought about by economic growth, pressures on the public increased, and social unrest deepened.



This led to Park Chung-hee being assassinated in 1979 by Kim Jae-kyu, the head of the South Korean Central Intelligence Agency (KCIA). After Park's death, Choe Kyu-ha was appointed acting president. The new administration repealed the laws enacted during Park's regime that banned opposition and criticism. However, these changes were insufficient to pacify social movements, and by 1980, demands for reform and student protests intensified. The opposition demanded the lifting of martial law in the capital, Seoul, and the removal of General Chun Doo-hwan, the head of the intelligence agency and the South Korean military, who was criticized for his influence over the state apparatus. In response, General Chun expanded martial law nationwide and suppressed the opposition through military methods. Opposition leaders were arrested, and all political activities were banned.

Despite the repression, more than 50,000 people participated in protests in May 1980, and martial law troops responded with armed intervention. During these events, dozens of protesters were killed, and hundreds were arrested. South Korea's transition to democracy was only made possible in 1987 through widespread reforms after these repressive periods.

Chun Doo-hwan's rule was institutionalized with a seven-year presidential term, but mass protests and social unrest continued during this period. In 1983, 17 ministers from Chun's cabinet were killed in a bombing attack carried out by North Korean commandos in the capital of Burma, Rangoon. Following this event, Chun appointed Roh Tae-woo as his successor, resigned, and withdrew from public life by retreating to a monastery.

Despite its authoritarian nature, Chun Doo-hwan's administration is notable for two key policy moves: securing a \$4 billion loan from Japan and hosting the 1988 Summer Olympics in South Korea. Roh Tae-woo, who succeeded him, made some missteps in economic policies but exhibited a relatively more democratic governance. Roh developed diplomatic relations with North Korea and other communist countries, and during this period, North Korea expanded its international relations by opening consulates in 172 countries.

In 1993, Kim Young-sam was elected president with the vision of a "New Korea" and prioritized combating corruption, economic reforms, and strengthening national discipline. Kim's administration aimed to make South Korea more politically and economically transparent.

Among the Southeast Asian Tigers, Thailand, Malaysia, and Indonesia have been presented by the IMF and the World Bank as successful examples of the "capitalist development model." These countries embraced global economic integration, implemented an exportdriven free-market economy, and kept state intervention to a minimum. Foreign capital, in line with market dynamics, directed significant investments into these countries.

However, South Korea's development process followed a different path compared to the model adopted by the Southeast Asian Tigers, with the government playing an active role in the economy. Under an authoritarian state apparatus, South Korea steered its economic growth and achieved significant success in the process. This led to debates among IMF and World Bank experts about whether the free-market economy was the only valid model, particularly as South Korea joined the ranks of the "Tiger" economies.

In the mid-1980s, significant developments reshaped the economic balance in Asia without the need for IMF policies. During this period, trade tensions between the United States and Japan escalated, with the primary issue being the rapid dominance of Japanese products, particularly automobiles, in the American market. The U.S. demanded that Japan raise the value of the yen and end its dumping practices. Consequently, Japan had no choice but to comply with these demands in 1985, leading to a significant appreciation of the yen.



This development prompted Japanese exporters to shift production to foreign countries to maintain their profitability, accelerating Japan's direct foreign investment strategy. While much of Japanese capital flowed to the U.S. and Europe, Southeast Asian countries also benefited significantly from this process. Thailand, Malaysia, and Indonesia received at least \$15 billion in direct investment from Japan, which helped alleviate their economic issues. With these investments, the export-driven economic growth model based on industrial goods was quickly adopted, and these countries became significant exporters of industrial products to the U.S. market. Around the same time, South Korea and Taiwan followed a similar strategy, directing their investments into Southeast Asia and boosting economic activity in the region.

As a result of this process, the Asian Tigers emerged as countries capable of producing and exporting industrial products of international competitive quality. Economic growth accelerated, the middle class expanded, and poverty was partially reduced. However, a significant structural issue arose during this development process: the export sector was largely controlled by foreign companies. For example, by the late 1980s, 99% of Malaysia's electronics and computer products exports, 90% of machinery and electrical equipment exports, 80% of rubber product exports, and 75% of textile and ready-made garment exports were under the control of foreign companies.

The economic consequences of this situation soon became evident. By 1992, Thailand had a \$2.09 billion trade surplus with the U.S., but a \$8.3 billion trade deficit with Japan. This was because Thailand imported most of the raw materials and intermediate goods required for industrial production from Japan. Similarly, while Malaysia had a \$4.2 billion surplus in trade with the U.S., it faced a \$5.8 billion trade deficit with Japan. As the economies grew, these trade deficits continued to rise, deepening financial vulnerabilities. For instance, Malaysia's trade deficit rose from 4.8% of GDP in 1993 to 8.5% in 1995, and Thailand's trade deficit increased from 5.9% to 8.1%.

In response to these developments, the governments of the Asian Tigers sought various financial sources to close growing trade deficits and sustain their economies. However, some policy decisions taken during this period led to social and economic problems. For example, in an effort to increase foreign exchange earnings, the Thai government openly supported sex tourism, leading to a serious AIDS epidemic in the country. Additionally, workers' rights were suppressed, union activities were obstructed, and migrant workers from rural areas were brought in to provide low-cost labor. A 1994 report from the Thailand Development Research Institute noted that Thailand ranked among the world's five worst countries in terms of income inequality.

As a result, the economic growth of the Asian Tigers was largely based on foreign investments and an export-driven model, but this growth was not evenly distributed across society. Economic development primarily benefited the political and economic elites, deepening income inequalities and creating significant structural challenges for sustainable growth.

The 1997 Asian Financial Crisis is remembered as a major economic collapse that occurred during the rapid economic growth process in East and Southeast Asia, creating profound effects on the global financial system. Countries known as the Asian Tigers—Thailand, Indonesia, Malaysia, South Korea, and the Philippines—achieved high growth rates during the 1980s and early 1990s, but the crisis in 1997 led to severe economic contractions in these countries (Alath, 2001).



Several factors played a role in the emergence of the Asian Financial Crisis. The key contributing factors include:

Fixed Exchange Rate Regimes and Speculative Attacks: Many Asian countries had pegged their currencies to the U.S. dollar. However, this system led to the overvaluation of local currencies and a decrease in export competitiveness. Speculative attacks on Asian currencies accelerated capital flight, triggering the crisis.

Excessive Borrowing and Weak Banking Systems: Banks and companies in the region adopted a growth model based on external borrowing. However, the inability to repay debts and the lack of adequate banking regulations increased economic vulnerability.

Current Account Deficits and Investment Bubbles: The Asian Tigers were characterized by high current account deficits and overvalued asset prices. Speculative bubbles, particularly in the real estate and stock markets, led to a sharp collapse during the crisis.

In July 1997, Thailand was forced to float its baht after depleting its foreign exchange reserves. This led to a devaluation of the currencies of other Asian countries. Subsequently, economic contractions accelerated in countries like Indonesia, Malaysia, and South Korea. The International Monetary Fund (IMF) provided credit packages to the affected countries to prevent the spread of the crisis, but these aids were combined with stringent fiscal policies, making the recovery process challenging.

The economic and social effects of the Asian Tigers crisis can be assessed in terms of economic, financial, and socio-political impacts (Keskin, 2024b):

Effects on Economic Growth: Many Asian countries experienced double-digit contraction rates. In South Korea, industrial production shrank, while unemployment rates rapidly increased in Indonesia and Thailand.

Effects on the Banking and Financial Sector: Banks went bankrupt, financial systems had to be restructured, and foreign investors withdrew capital from the region.

Social and Political Consequences: Unemployment and income losses led to significant public unrest. In Indonesia, President Suharto's regime was overthrown due to the effects of the crisis, and political instability increased in several countries.

In the post-crisis period, Asian countries implemented various reforms to strengthen their economic and financial systems:

Flexibility in Exchange Rate Policies: Fixed exchange rate regimes were abandoned, and more flexible exchange rate policies were adopted.

Banking Reforms: Banking sector regulations were tightened, and risk management strategies were developed.

Regional Cooperation: ASEAN+3 countries established mechanisms such as the Chiang Mai Initiative to enhance regional cooperation against financial crises.

CONSEQUENCES OF THE ASIAN FINANCIAL CRISIS FOR THE COUNTRIES

The Asian Crisis emerged in 1997 and negatively impacted many Asian countries in various ways. By 1998, the lingering effects of the crisis included low growth rates, even contractions, and increasing external debts. The crisis, which began with the devaluation of the Thai Baht and spread to other countries such as Indonesia, Malaysia, the Philippines, South Korea, Japan, and Singapore, negatively affected the economic growth of these nations. The crisis marked the end of the "Asian Miracle" that had previously characterized the region's rapid economic ascent.

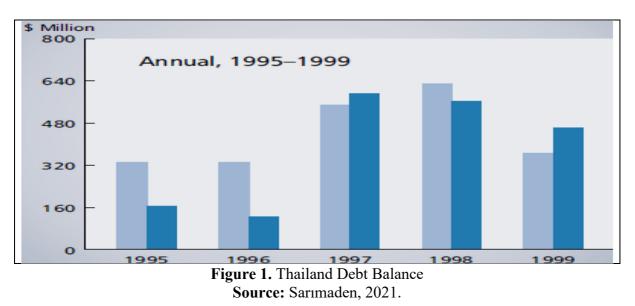


After the Asian Crisis, the damage in these countries was significant. Millions of people lost their jobs, and rising poverty severely impacted daily life. Asian economies, which were heavily dependent on international trade, faced challenges in protecting themselves from external shocks that could further harm their economies. These countries required sufficient foreign exchange to shield themselves from adverse impacts, especially when financing for foreign trade was unavailable. For example, South Korea, unable to risk using its foreign exchange reserves for foreign trade, found itself in a tight economic spot (Lee, Rhee, 2012).

Thailand

In Thailand, the impacts of the crisis were not as severely destructive as in other countries. With the loan package provided by the IMF, austerity measures were implemented. However, Thailand needed to reduce its current account deficit and increase its GDP, which led to an economic slowdown. In 1997 and 1998, the growth rates were at zero and -2%, respectively, and further contraction occurred. The Thai Baht depreciated, which exacerbated inflationary pressures and made it more difficult for Thai companies to repay debts listed in foreign currency on their balance sheets.

The devaluation of the Thai Baht was one of the rare situations where price competitiveness in exports improved. The current account deficit, which had been 8% of GDP in 1995 and 1996, reduced to 1.5%, but by 1998, there was a surplus of 3.5%. However, the devaluation of the Baht, combined with foreign currency-denominated debts, pushed the country into a deeper crisis, causing the currency to continue weakening. Similar to the Mexican Crisis at the beginning of 1995, Thailand experienced a collapse in consumption, investment, and retail sales.



In 1998, Thailand experienced an unprecedented contraction in GDP. However, by the beginning of 1999, the situation began to show positive signs. With increased utilization of production capacity, rising consumption, and government incentives, Thailand's GDP grew by 4% in 1999. The domestic demand, which had contracted the previous year, rose by 8.5% in 1999. The private investment index continued to decline, but compared to the 40% decrease in 1998, it rebounded to zero growth by December 1999.

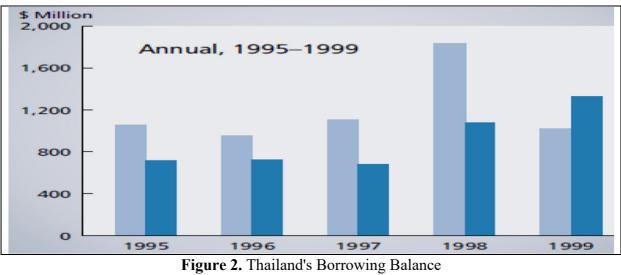


The major Asian Financial Crisis of the mid-1997 hit Thailand hard, leading to high unemployment. The continuing unemployment reached 5.9% of the total workforce, equating to 1.9 million people in 1999. Underemployment, a concept that examines and assesses the productivity of the workforce, significantly increased in Thailand. People who were forced to work in jobs requiring lower levels of knowledge and skills, despite deserving higher wages, were considered underemployed. Temporary employment also increased during this period. Thailand had a high inflation rate of 8.1% in 1998, but this situation changed in 1999. The prices of food and agricultural products dropped, leading to a decrease in inflation, which was maintained at 0.3% in 1999 (Asian Development Bank, 1999).

Indonesia

The statements made by Bank Indonesia have brought to light the vulnerabilities of the country's economy. According to the announcement, out of the total external debt of \$130 billion, \$9.6 billion was set to mature in March. Additionally, high borrowing costs were driving interest rates higher. In Indonesia, where demand for the U.S. dollar was strong, funds would need to be hedged in case of a depreciation of the Rupiah. The banking and financial sector suffered heavy losses, prompting authorities to take action, starting with the closure of 16 out of the country's 239 banks.

The rapid depreciation of the Rupiah led to rising inflation, increasing the need for economic support, and as a solution, an aid package was requested from the IMF. As economic stagnation deepened, social unrest grew in the country, while similar struggles were observed in other Asian nations. In 1998, Thailand's economy contracted by 5%. Due to the vulnerability of regional currencies against the U.S. dollar, Rupiah sales accelerated, making further depreciation inevitable. These developments demonstrated that a loose monetary policy did not offer an effective solution, leading Thailand to revert to a tight monetary policy. For Indonesia, maintaining Rupiah stability remained a crucial priority (Asian Development Bank Annual Report, 1998).



Source: Sarımaden, 2021.



Figure 2 illustrates how fluctuations in borrowing and lending rates in Indonesia changed in terms of U.S. dollars. Indonesia became a member of the Asian Development Bank in 1966 and, over this period, utilised a total of 247 loans. By the end of 1999, 80 of these loans were still active. The funds were allocated to designated projects, and the relevant agreements were signed. The bidding rate in these agreements was recorded at 30.5%. While the amount of loans disbursed reached \$1.3 billion, total repayments amounted to \$10.6 billion. Specifically, in 1999, the repayment rate was recorded at 24.8%.

The Philippines

The most distinguishing characteristic of the Philippines compared to its neighboring countries is the limited inflow of foreign capital, which has prevented sudden and large-scale capital outflows. With a lower GDP growth rate than other countries in the region, the Philippines was affected by the depreciation of the Peso. This depreciation led to increased inflation, putting pressure on the economy and forcing the Central Bank of the Philippines to implement monetary policies. Although not as severely as Thailand and Malaysia, the Philippines also took on significant risks in the real estate sector (Asian Development Bank Annual Report, 1998).

In 1998, the Philippine economy experienced a sharp contraction due to the effects of El Niño. By 1999, although the impact of the Asian Financial Crisis was still felt, the country had entered a recovery phase. In particular, after negative GDP growth in 1998, the economy showed signs of recovery in 1999 with a 3.2% increase in GDP. The economy, which had been severely affected by El Niño in 1997 and 1998, regained momentum in 1999, especially with the revival of the agricultural sector. However, the expected improvement in the industrial sector did not materialize, and due to ongoing issues in domestic demand, the industrial sector recorded only a modest growth rate of 0.5%.

Despite a decline in inflation rates, economic concerns persisted. Inflation, which stood at 9.7% in 1998, dropped to 6.6% in 1999. Although the agricultural sector improved, weak overall demand limited the extent of economic recovery.

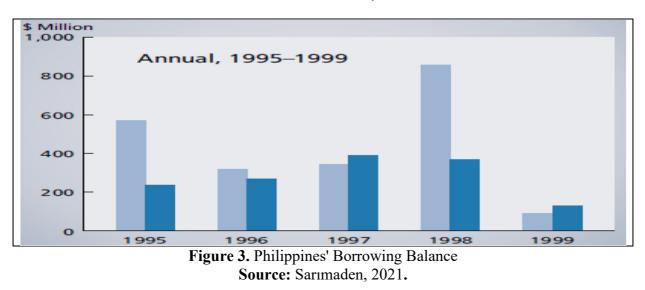


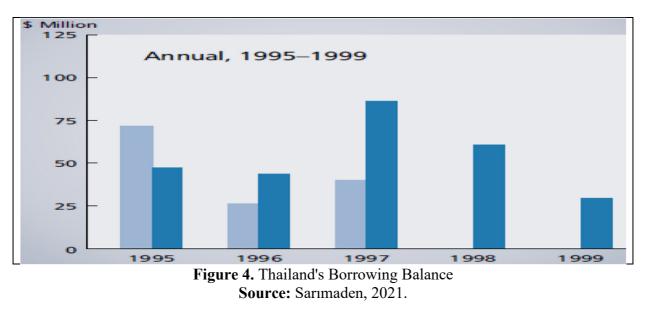
Figure 3 presents the borrowing and debt repayment rates of the Philippines.



Malaysia

Malaysia's financial sector suffered significant losses. The country's GDP growth rate, recorded at 7.5% in 1997, declined sharply to 1.5% in 1998. The primary cause of Malaysia's economic problems was not external debt but the excessive overvaluation of domestic assets. In particular, sharp declines in the real estate and stock markets negatively impacted the banking and financial sectors. Although interest rates were lowered to 20%, monetary growth expectations remained at only 9%. On the other hand, raising interest rates led to higher borrowing costs, creating inflationary pressures. Bank Negara Malaysia aimed to control inflation by increasing interest rates. However, the effectiveness of this strategy remained uncertain. It was emphasized that interest rates were only one variable in combating inflation and should not be considered in a direct cause-and-effect relationship. Since rising interest rates could slow economic growth and destabilize financial markets, Bank Negara Malaysia took a cautious approach to rate hikes.

A loose monetary policy led to rising inflation expectations and deepened economic challenges. In 1998, the inflation rate was recorded at 5.3%, but it declined to 2.8% in 1999, indicating a downward trend. This decline in inflation was partly due to the positive effects of excess capacity, which helped slow the increase in food prices. The importance of sound financial management and efficient resource utilization became more evident during this period. To strengthen the banking sector, Malaysia took steps to solidify its capital structure by merging financial institutions and implementing financial sector reforms (Piaw & Jais, 2013).



As seen in Figure 4, Malaysia's real national income growth experienced fluctuations due to the impact of the 1997 Asian Financial Crisis. While the country faced a temporary economic loss during the crisis, it gradually recovered and returned to a growth trajectory. By the early 2000s, Malaysia's real national income showed an upward trend once again.



Singapore

Singapore's economic trajectory differed from Malaysia's experience. In terms of key economic indicators, Singapore was in a stronger position compared to Malaysia. The controlled depreciation of the U.S. dollar enhanced the country's trade competitiveness. Although the Singapore dollar depreciated by 17% against the U.S. dollar in 1997, this impact was balanced by strong demand from the United States. The manufacturing, finance, construction, and electronics sectors experienced significant demand growth, contributing positively to economic expansion. GDP growth projections for 1997 and 1998 were initially positive, but 1998 was ultimately characterized as a period of economic stagnation. This unexpected resilience during the crisis was surprising.

However, Singapore also faced certain challenges. The Singapore dollar was not strong enough against the currencies of neighboring countries. While it maintained some resilience against the U.S. dollar, it weakened regionally. After experiencing sluggish growth in 1998, the Singaporean economy rebounded in 1999 with a 5.4% growth rate. This recovery was largely driven by strong external demand for electronics and hardware, along with increased production. Other sectors also benefited from this growth, with the pharmaceutical and chemical industries experiencing notable expansion. Although the construction sector showed an overall positive outlook, a sharp decline in private construction investments led to a downturn in the industry.

In 1999, trade and tourism significantly contributed to economic recovery. The rising number of tourists boosted the restaurant and hotel industries, stimulating domestic demand. However, bank loans, apart from housing loans, lagged behind the economic recovery, showing weaker performance compared to improvements in the industrial sector. Inflation declined by 0.2% in 1998 and fell by another 0.6% in the first half of 1999. Despite an increase in transportation, communication, and food prices in the second quarter, overall inflation remained low throughout the year.

Although Singapore maintained a trade surplus in 1999, it experienced a decline compared to 1998. While demand for electronics increased, the depletion of raw material and intermediate goods inventories offset this growth. Nevertheless, the strong demand in the tourism sector played a crucial role in supporting economic expansion. As a result, in 1999, Singapore managed to increase its trade surplus and, despite the lingering effects of the crisis, evolved into a more open economy, solidifying its position as a key global trade hub (Asian Development Bank Annual Report, 1999).

South Korea

Although the \$57 billion bailout package provided by the IMF created a sense of optimism in the South Korean economy, the looming \$100 billion in external debt due in December 1998 quickly overshadowed this optimism. South Korea's economic situation was similar to the crisis in Thailand. While the government officially reported external debt at \$63 billion, by 1998, the actual debt had reached \$119.7 billion. However, even these figures were believed to underestimate the true scale of the debt.

The government initially projected GDP growth of 3% for 1998, whereas the IMF set a more conservative estimate of 2.5%. However, the actual growth rate fell below even these predictions, raising concerns about the reliability of economic data. The heavy external debt burden and rising unemployment delayed economic stabilization and the mitigation of the crisis's effects. Nevertheless, the IMF's support packages played a crucial role in South Korea's recovery process.



In 1998, the South Korean economy contracted by 6.7%, but this was reversed in 1999 with an impressive 10.7% growth rate—one of the highest recorded since 1988. This rapid recovery was driven by increased exports, revived domestic demand, and a rise in private consumption and investment. The unemployment rate also declined significantly throughout 1999, peaking at 8.6% in February before falling to 4.8% by the end of the year, reflecting the positive impact of economic recovery on the labor market. There were also notable improvements in inflation. The inflation rate dropped from 7.5% in 1998 to just 0.8% in 1999, demonstrating the return to economic stability in the post-crisis period. These figures were regarded as key indicators of South Korea's economic rebound.

One of the primary reasons South Korea was less affected by the crisis compared to other Asian countries was its strong presence in global technology markets. By 1997, major corporations such as LG Electronics, Samsung Electronics, and Hyundai Electronics had established themselves as leading manufacturers in telecommunications, information systems, consumer electronics, and imaging technologies. By 2000, companies like Hyundai and Samsung were responsible for nearly half of the world's production of Dynamic Random-Access Memory (DRAM) chips.

During the Asian Financial Crisis, these companies maintained production and continued expanding internationally. However, the crisis prompted them to reassess their strategies. Prior to 1997, South Korean conglomerates focused on aggressive expansion, but in the post-crisis period, they shifted towards efficiency and profitability. This strategic transformation became a key factor in South Korea's economic recovery (Kwon et al., 2004).



Figure 5. South Korea Debt Balance Source: Sarımaden, 2021.

As seen in Figure 5, by 1998, the Philippines had lost its ability to extend loans and was only able to repay its existing debts.

South Korea implemented a securities nationalization program that lasted until the end of 1991. However, during this period, foreign investors could only access stocks through private investment partnerships. By 1992, the Korean stock market was opened to foreign investors, allowing non-Korean investors to directly purchase shares. During this period, the government actively encouraged foreign investments.

Following the 1997 Asian Financial Crisis, all barriers restricting foreign capital participation in local companies were completely lifted in 1998 (Joe & Dongchuhl, 2017).

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Japan

In the November 1992 elections, Bill Clinton defeated George H. W. Bush and became the President of the United States. In 1993, Clinton aimed to strengthen trade relations with Japan. As one of the world's leading producers of high-quality goods, the U.S. sought to access the Japanese market in the same way that Japan had entered the American market. However, that same year, a challenge emerged that hindered the U.S. economic recovery: the growing trade deficit caused by increasing imports from Asia. During this period, the U.S. dollar continued to depreciate against the Japanese yen. The yen's appreciation and the dollar's decline persisted until a meeting in 1993 between Clinton and Japanese Prime Minister Miyazawa. Clinton sought to boost U.S. exports to Japan while curbing the rapid rise in Japanese imports. This strategy aimed to strengthen the dollar against the yen to maintain economic balance. However, as Japan's economic stagnation continued, the change in the country's leadership was not well received by financial markets.

Meanwhile, 40% of Indonesia's external debt was denominated in Japanese yen. At the beginning of 1995, as the yen appreciated, Indonesia's debt burden increased by 10%. Similarly, since the South Korean won gained more value against the U.S. dollar than the yen, South Korea gained an export advantage over its Japanese competitors and reduced its import costs. This development strengthened South Korea's competitive position, allowing it to surpass Japan in certain markets.

One of the warning signs of the Asian financial crisis was the collapse of Japan's economic bubble and the Bank of Japan's decision to raise interest rates to mitigate inflationary pressures. In the 1980s, Japan had some of the world's most expensive real estate. However, central bank interventions led to an economic slowdown. Loose monetary policies intended to curb inflation eventually created a deflationary environment, which accelerated over time. As a result, Japan lost its status as a reliable market for investors, leading to capital outflows.

In addition to the U.S., countries such as Thailand, Indonesia, and Singapore shifted their investments toward Asia due to high growth rates. In 1986, 80% of Japanese investors' shares were in the U.S., while 14.4% were in Southeast Asia. By 1994, these proportions had shifted, with 40% of Japanese shares moving to Southeast Asia, while the U.S. share declined to 38.8% (Asian Development Bank Annual Report, 1996). During the Asian financial crisis, creditor nations suffered significant losses, and Japanese banks began withdrawing funds from other countries, creating substantial risks. Throughout the crisis, Japan remained in the position of a lender (Chan & Dang, 2012).

Hong Kong

To minimize the effects of the 1997 Asian financial crisis, Hong Kong sought to strengthen its ties with the Chinese economy. The Hong Kong Monetary Authority intervened to prevent the local currency from depreciating against the U.S. dollar by sharply increasing interest rates. In an attempt to balance the selling pressure on the Hong Kong dollar, the government restricted supply and tried to stimulate demand by adding liquidity to the market, while also withdrawing a certain amount of liquidity. However, the burden of these interest rates fell on the market, and Hong Kong ceased to be as affordable as it once was.

Hong Kong's economy contracted by 5.1% in 1998, but in 1999, it grew by 2.9%, marking the beginning of a recovery process. Although government spending increased, much of the growth was driven by improvements in private consumption. However, uncertainty in the investment environment, high real interest rates, and a lack of business confidence persisted.



In the second quarter of 1999, economic activity increased, and falling nominal interest rates helped revive consumer demand. Retail sales fell by 16.7% in 1998, but this decline reduced to 8.1% in 1999. Private consumption also showed a modest increase of 1.1%. This limited growth was mainly due to high unemployment, low wage increases, and economic uncertainty.

Before the crisis, the unemployment rate stood at 3%, but by 1999, it had doubled to 6%. The construction sector saw the highest unemployment rate at 12.7%. However, positive developments occurred as the participation rate of women in the workforce increased, seen as a significant step for both social equality and economic development. Additionally, inflation showed a downward trend, and price reductions became more pronounced in 1999 compared to 1998. The overall consumer price index dropped by 4%, signaling a deflationary period. This decline was influenced by the government's decision to halt wage increases and the increased price competition.

Although not directly observable in 1999, Hong Kong's trade surplus widened. Hong Kong's exports to Asia enhanced the region's attractiveness. Despite experiencing negative growth during the crisis, Hong Kong recorded a positive growth rate in 1999, rising from 6.8% to 11.8%, following a recovery in exports. While there was no significant change in trade, a slight decrease in both imports and exports was observed. China's integration into global trade created new trade and service opportunities for Hong Kong. Its membership in the World Trade Organization (WTO) was one of the key factors strengthening these opportunities.

After the Asian crisis, the Hong Kong government adopted a more transparent, marketoriented, innovative, and regulatory approach to maintain its financial system. In 1998, consultations with the banking sector took place, and in 1999, various financial regulations were implemented after gathering public feedback. Many new regulations, including those related to interest rate policies, were introduced. The economic downturn was severe, and the Hong Kong government was forced to revise the balanced budget policy it had initiated in 1998. The budget deficit stood at 23.2 billion Hong Kong dollars (1.8% of GDP) during 1998-1999, but by the 1999-2000 period, this deficit was reduced to 1.6 billion Hong Kong dollars (0.1% of GDP).

While the education sector saw significant expansion, the most notable improvements occurred in social welfare. The government aimed to continue a controlled expansion process by increasing production. To stimulate demand in the private sector, a 10% tax rebate was introduced in the real estate sector, as well as on wages and profits. The government prioritized reforms in healthcare and education, promoting sustainable development in these sectors (Asian Development Bank Annual Report, 1999).

Regionally, Hong Kong had to carve out its own economic path. However, China's influence on the region shaped Hong Kong's economic trajectory. Despite China's economic performance being an important indicator for Asia, China was less affected by the Asian Crisis compared to other countries. On the other hand, Hong Kong was one of the regions most exposed to the effects of the crisis. China emerged as one of the fastest-growing and developing economies in the world. With the reforms initiated in 1978, China attracted foreign capital, achieving faster economic growth. While direct foreign investments played a major role, China's growth slowed after the 1997 crisis. The devaluation of currencies in neighboring countries and the spread of the crisis led to a decrease in investments, negatively impacting growth. However, the scale of this adverse impact remained limited (Waryoba, 2017).



FINDINGS

1. Spread of the Crisis and Financial Instability: The crisis had a severe impact on the financial markets of many countries in the region, primarily due to high external debt levels and weak financial oversight. Countries like Thailand, Indonesia, and Malaysia experienced significant economic contractions as a result of currency crises. These crises led to currency devaluation, which in turn hurt international investments.

2. South Korea South Korea, which had experienced rapid economic growth before the crisis, faced serious external debt problems and bank failures during the crisis. With the intervention of the IMF, the country tried to recover, but high unemployment, inflation, and economic contraction weakened domestic demand in 1997-1998. The decline in foreign investments further slowed South Korea's economic growth.

3. Post-Crisis Thailand: In Thailand, the crisis quickly spread to neighboring countries. Due to the currency crisis, investments decreased, leading to a contraction in production capacity. Post-crisis, the government implemented structural reforms and tightened fiscal policies, which were crucial steps toward achieving renewed growth.

4. Hong Kong and Singapore: Although Hong Kong was less affected by the crisis compared to other Asian countries, it still experienced economic contraction. China's slowing growth rate impacted Hong Kong's external trade and financial markets. Singapore faced some challenges in its aspiration to become a financial center but showed resilience and entered a recovery phase in its economy.

5. Malaysia and Indonesia's Impact from the Crisis: Malaysia and Indonesia were severely affected by the Asian Crisis. High external debt levels, a weak financial sector, and fragile economic structures led to significant economic contractions in these countries. Indonesia's economy collapsed following the 1997 devaluation, while Malaysia sought recovery through intervention packages and policy reforms after the crisis.

6. Japan's Post-Crisis Situation: Japan was less affected by the Asian Crisis but had already been weakened by its bubble economy in the early 1990s, followed by stagnation. The regional crisis compounded Japan's economic difficulties, with high unemployment and slow economic growth damaging investor confidence.

7. Decline in International Investments Due to the Crisis: During the crisis, many countries in the region faced a reduction in foreign investments. This situation slowed the flow of international capital and hindered economic growth, especially for the emerging economies in Asia. Foreign capital inflows, largely consisting of short-term and speculative investments, quickly exited the region with the onset of the crisis.

8. Investor Confidence and Restructuring: To minimize the crisis's effects, these countries began implementing structural reforms and fiscal stability policies. They also took steps to rebuild market confidence to attract foreign investments. Once investor confidence was restored, these countries began making progress toward achieving growth again (Keskin, M. (2025).

The Asian Crisis revealed the vulnerabilities and external dependencies of the region's economies. Economic reforms implemented after the crisis, particularly strengthening financial sector regulations and regulating foreign exchange markets, contributed to the region's economic recovery. However, issues such as external debt management and control over capital flows during the crisis period need more attention to restore investor confidence.

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RECOMMENDATIONS

Reduction of External Debt and Strengthening Financial Regulations: The 1997 Asian Crisis clearly demonstrated that excessive external borrowing and weak financial regulations can lead to economic crises. Therefore, the Asian Tigers need to limit their levels of external borrowing and strengthen financial regulations. Managing external debt should be a priority for ensuring long-term sustainable growth. Furthermore, increasing the transparency of financial markets and strengthening regulations are vital to preventing potential crises.

Strategies for Attracting International Investments: During crises, the rapid withdrawal of international investments can deepen economic collapse. Therefore, Asian countries need to establish strong market security to attract international investments. Investor confidence should be supported by macroeconomic stability and financial transparency. Countries should develop policies to attract investors and create more robust structures in their financial markets.

Diversification of Domestic Economies: Crises have exposed the vulnerabilities of economies that are overly dependent on external factors. Therefore, it is clear that the Asian Tigers need to diversify their domestic economies. Investments in high-growth potential sectors should be increased, and domestic markets should be strengthened. In particular, domestic investments in technology, green energy, and innovative industries should be encouraged. This will enhance economic resilience and make the economy more resistant to external shocks.

Enhancing Crisis Response and Management Capacity: In times of crisis, governments need to be able to intervene quickly and effectively. Therefore, the Asian Tigers must increase their crisis management capacity. Public-private sector collaborations will enhance the ability to produce rapid solutions before and after crises. Additionally, active fiscal and monetary policies should be implemented during crisis periods to restore economic growth.

Strengthening Regional Cooperation: Strengthening economic cooperation between countries in Asia will help create a more resilient structure against regional crises. Common financial regulations, trade, and investment agreements, and regional cooperation can minimize the effects of crises. Furthermore, information sharing between Asian countries should be promoted, and joint pre-crisis and post-crisis strategies should be developed.

CONCLUSION

The 1997 Asian Crisis provided important lessons for the Asian Tigers and other countries in the region. The crisis resulted in significant challenges in terms of economic growth, stability, and international investments. However, it also highlighted the vulnerabilities of Asian economies and became a turning point for structural reforms.

In the post-crisis period, many Asian countries have revisited their economic policies and strengthened their integration with the international financial system. One of the key lessons learned from the crisis is the need to increase economic diversification and internal resilience. Furthermore, strengthening financial regulations is critical to ensuring the sustainability of both domestic and international investments.

Countries like South Korea, Thailand, Malaysia, Indonesia, and others have implemented various reforms to build a stronger economic foundation as they recovered from the crisis. Asian countries need to create safer and more transparent market environments for international investors to manage future crises more effectively.

In conclusion, the Asian Tigers and other Asian economies continue to move forward in building stronger and more resilient economies, drawing lessons from the crisis. However, continuous improvement and adaptation remain crucial in this process.



Ensuring investor confidence, diversifying domestic economic structures, and enhancing crisis management capacity will be fundamental elements for the sustainable economic growth of Asia.

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EXPLORING THE TOUR ROUTE PLANNING CAPABILITIES OF ARTIFICIAL INTELLIGENCE-ASSISTED CHAT ROBOTS: A COMPARATIVE ANALYSIS

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ABSTRACT

This study aims to conduct a comparative analysis of the travel recommendations provided by AI-powered chatbots and to identify the differences among these systems. In contemporary travel planning, AI-powered chatbots play a significant role, assisting users in selecting the most suitable destinations based on their preferences. However, the recommendations offered by different AI-powered chatbots may vary in terms of content quality, accuracy and personalization. In this context, determining the abilities of AI-Assisted chat robots to generate user focused and personalized tour itineraries is vital for their future applications in the tourism sector. Aligned with this objective, a qualitative research method was adopted. Five AI-powered chatbots-ChatGPT, Google Gemini, Microsoft Copilot, Claude AI, and Perplexity AI-were each asked the same prompt, and their responses were assessed through a comparative approach. The travel recommendations of these chat robots were analyzed based on criterias such as itinerary planning, means of transportation, activities, local cuisine, and additional suggestions. The findings reveal that each AI-Assisted chat robot features distinct strengths and weaknesses. In conclusion, various insights have been proposed to augment the effectiveness of AI-powered chat robots in travel planning. These suggestions mainly concantrate on how to enhance user experience and increasing the precision of AI-generated travel itineraries.

Keywords: Artificial Intelligence, Chatbots, Tour Route Planning

YAPAY ZEKA DESTEKLİ SOHBET ROBOTLARININ TUR ROTASI PLANLAMA YETENEKLERİNİ KEŞFETMEK: KARŞILAŞTIRMALI BİR ANALİZ

ÖZET

Bu çalışma, yapay zekâ destekli sohbet robotlarının kullanıcılara sundukları tatil rotalarını karşılaştırmalı bir şekilde analiz ederek ilgili robotlar arasındaki farklılıkları ortaya koymayı amaçlamaktadır. Günümüzde yapay zekâ destekli sohbet robotları, seyahat planlamasında önemli bir rol oynamakta ve kullanıcıların tercihlerine göre en uygun destinasyonları seçmelerine yardımcı olmaktadır. Ancak, farklı yapay zekâ destekli sohbet robotlarının sunduğu öneriler, içerik kalitesi, doğruluk ve kişiselleştirme açısından birbirinden farklılık gösterebilmektedir. Bu bağlamda yapay zekâ tabanlı sohbet robotlarının kullanıcı odaklı olarak kişiye özel tur rotası planlamaya yönelik yeteneklerinin ortaya koyması turizm sektöründe kullanımının geleceği açısından önem taşımaktadır. Bu doğrultuda gerçekleştirilen çalışmada nitel araştırma yöntemi benimsenmiştir.



Bu bağlamda, ChatGPT, Google Gemini, Microsoft Copilot, Claude AI ve Perplexity AI olmak üzere beş farklı yapay zekâ destekli sohbet robotuna bir adet soru sorulmuş ve verdikleri yanıtlar incelenerek karşılaştırmalı bir analiz gerçekleştirilmiştir. Çalışmada, sohbet robotlarının sunduğu tatil önerileri ziyaret planı, ulaşım şekilleri, aktiviteler, yerel tatlar ve tavsiyeler gibi kriterler çerçevesinde değerlendirilmiştir. Gerçekleştirilen analiz sonucunda, her bir yapay zekâ destekli sohbet robotunun farklı güçlü ve zayıf yönlere sahip olduğu görülmüştür. Son olarak, yapay zekâ destekli sohbet robotlarının seyahat planlaması alanında daha etkin kullanılabilmesi için öneriler geliştirilmiştir. Bu öneriler, kullanıcı deneyimini iyileştirme ve yapay zekâ sistemlerinin doğruluk payını artırma üzerine odaklanmaktadır. **Anahtar Kelimeler:** Yapay Zekâ, Sohbet Robotları, Tur Rotası Planlama

INTRODUCTION

Artificial intelligence (AI) technologies are continuously evolving and becoming increasingly common in daily life (Tlili et al., 2023). These technologies, which have shown development in various fields, including the tourism sector, operate as systems that think and act like humans. They possess advanced capabilities such as functioning as expert systems by teaching computers knowledge and decisions related to specific expertise, understanding natural language spoken and written by humans through natural language processing, and providing rapid responses (Türkay, 2024:1880). AI and robotics technologies are widely used in the tourism industries to enhance operational efficiency, increase employee productivity, and accelerate and improve service processes (Mich & Garigliano, 2023; Ivanov et al., 2017). Moreover, these technologies offer advantages in the tourism sector due to financial benefits such as reducing purchasing and personnel costs (Sugasri & Selvam, 2018).

In the 21st century, tourists engage in multiple activities simultaneously during their travels, visit numerous destinations, and maintain continuous connectivity with others. Furthermore, they are regarded as individuals who access and process large volumes of data, leveraging digital technologies to rapidly compare information and expedite their decision-making processes (Ercan, 2020:401). In this context, one of the significant applications of artificial intelligence (AI) technologies in the field of tourism is facilitating tourists in planning their travel itineraries (Wong et al., 2023). The travel itinerary planning process encompasses the acquisition of relevant information, the generation of a set of destination options, the evaluation of these alternatives, and the formulation of a comprehensive travel plan for forthcoming trips (Ayeh et al., 2013; Xiang et al., 2015).

Before their travels, tourists perform research across multiple platforms about various aspects such as their destination, accommodation, dining options, and transportation methods (Çiçekdağı, 2024:1). Social media, tourism-related websites, and platforms featuring user reviews are among the primary sources utilized for this purpose (Karaca & Özkan Önem, 2023:191). Despite the vast amount of information available from these sources, identifying the necessary data and making informed decisions can be both challenging and time-consuming (Wong et al., 2023). With advancements in technology, new services have emerged to facilitate tourists' access to essential information, leading to transformations in information-seeking processes (Sperlí, 2021). In the last few years, advancements in artificial intelligence (AI) and natural language processing (NLP) technologies have made possible to the integration of AI-Assisted chat robots within the tourism industry. These technologies offer users with user-friendly and efficient solutions at every stage of their travels, by improving their overall experience (Şimşek, 2023).



Applications known as AI-Assisted chat robots are designed to facilitate seamless access to information for users who interact with them via a variety of communication channels (Güvenol et al., 2023). ChatGPT and other AI-powered technologies hold the potential to revolutionize the marketing strategies of the travel industry by offering personalized travel suggestions (Gursoy et al., 2023:581; Akpur, 2023:94). Utilizing rapidly gathered and processed data from multiple travel platforms, AI-powered chatbots can assist tourists in planning their travel itineraries by providing personalized recommendations based on their preferences, duration of stay, and budget constraints as stated during interactions (Ali et al., 2023; Carvalho & Ivanov, 2024).

Lately, studies examining AI-powered chatbots in the field of tourism have analyzed different aspects of their use. Some studies have focused on the potential difficulties that may encountered by users of generative AI technologies such as ChatGPT in the tourism sector (Dwivedi et al., 2024), Whereas some researchers have aim to identify the potential areas of application for ChatGPT within the industry (Cabi Bilge, 2023; Karaca & Özkan Önem, 2023). Moreover, it has been analyzed İzmir cuisine under the themes of culinary arts, food, and gastronomy using ChatGPT, Chatsonic, YouChat, Character.ai, and Bing AI Chat (Güvenol et al., 2023). Other studies have examined ChatGPT's contributions to various tourism-related sectors, including accommodation, service, transportation, entertainment, food and beverage, adventure and outdoor recreation, travel, events, and attractions (Erul & Işın, 2023). Furthermore, research has investigated AI-supported applications that hotel managers can utilize in their business processes (Akgün, 2023), identified user preferences in the field of recreation and assessed the contribution of ChatGPT-powered chatbots to the future of recreational activities (Genc, 2023), and analyzed user satisfaction with AI chatbots in enabling communication in their native language and accessing relevant regional options in Saudi Arabia's second-largest city (Alotaibi et al., 2020). Additionally, studies have evaluated the adoption and use of chatbots in India (Pillai & Sivathanu, 2020). Although various studies in the relevant literature focus on AI chatbots in the tourism industry, limited research has specifically examined the intersection of artificial intelligence and travel route planning (Akpur, 2023; Çiçekdağı, 2024; Penerliev, 2024). A review of the literature reveals that most studies primarily concentrate on ChatGPT. However, it has also been observed that Google AI Chatbot, Monica, Bing AI Chat, Chatsonic, YouChat, and Character.ai have been utilized in several studies. This study distinguishes itself from existing research by evaluating five widely used chatbots, including ChatGPT, Google Gemini, Microsoft Copilot, Claude AI, and Perplexity AI. This aspect constitutes a key element of the study's originality and is expected to serve as a foundation for future research in this field.

METHOD

This study aims to comparatively analyze the vacation routes recommended by different AIpowered chatbots, highlighting the variations among them. Identifying the capabilities of various AI-based chatbots in user-centered, personalized travel itinerary planning is crucial for assessing their future applications in the tourism industry. To achieve this objective, a qualitative research method has been adopted. Due to the difficulty of accessing all AI-based chatbots, the study is limited to five AI-powered chatbots that were accessible: ChatGPT, Google Gemini, Microsoft Copilot, Claude AI, and Perplexity AI. In alignment with the study's purpose, a single question in Turkish was directed to the selected AI-powered chatbots based on insights gathered from the literature (Akpur, 2023; Shin et al., 2023; Çiçekdağı, 2024; Penerliev, 2024). The study was originally conducted in Turkish.



Q1. Can you design a three-day travel itinerary for a family living in Balıkesir who is interested in cultural and gastronomic tourism and enjoys visiting museums, considering alternative travel destinations outside Balıkesir without any budget constraints?

FINDINGS AND DISCUSSION

In the study, the same research question was asked to AI-powered chatbots, and the responses were first presented in text form, followed by corresponding screenshots in sequence. Subsequently, a table categorizing the obtained responses is provided. The discussion based on the analysis of this table is also included in this section.

ChatGPT

Certainly! Taking into account that a family from Balıkesir is interested in cultural and gastronomic tourism, I am creating a three-day travel itinerary without budget constraints. This itinerary includes destinations outside of Balıkesir and is filled with historical and cultural landmarks, gastronomic experiences, and museum visits.

Day 1: İzmir – History and Flavors

Morning:

• **Delightful Breakfast:** Enjoy a traditional Turkish breakfast at one of İzmir's famous breakfast spots (Recommendation: A vineyard hotel in Urla or a local café in Alsancak).

• Kemeraltı Bazaar: Explore İzmir's historic bazaar and take a coffee break at Kızlarağası Han.

Lunch:

• Gastronomic Experience: Try İzmir's local delicacies such as *boyoz*, *kumru*, or *şevketibostan*.

Afternoon:

• **Museums:** Visit the İzmir Archaeological Museum and the Ahmet Piriştina City Archive and Museum.

• Alsancak Kordon: Take a seaside walk along the Kordon and enjoy the sunset.

Evening:

• **Dinner:** Savor modern interpretations of Aegean cuisine at a fine-dining restaurant in a vineyard hotel in Urla.

• Accommodation: Stay overnight at a boutique hotel in Urla or Alaçatı.

Day 2: Denizli – Pamukkale and Hierapolis Morning:

• **Early Departure to Pamukkale:** Travel from İzmir to Denizli (a 3-hour drive or by high-speed train).

• **Pamukkale Travertines:** Walk on the UNESCO-listed travertines and relax in the thermal pools.

Lunch:

• Local Cuisine: Enjoy regional delicacies such as *Denizli kebabı*.

Afternoon:

• Hierapolis Ancient City: Explore the ancient theater and historical ruins.

• Archaeological Museum: Learn about the rich history of Hierapolis.

Evening:

• Accommodation: Stay overnight at a thermal hotel in Pamukkale. You can also enjoy the hotel's spa and fine dining restaurant.

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Day 3: Afyonkarahisar – Gastronomy and History Morning:

- **Travel to Afyon:** A two-hour drive from Denizli to Afyonkarahisar.
- **Breakfast:** Enjoy a traditional breakfast featuring Afyon's famous *kaymak* (clotted cream).

Before Noon:

• **Afyon Castle:** Climb up to the castle for a panoramic view of the city.

• Victory Museum: Discover important artifacts from the Turkish War of Independence.

Lunch:

• Gastronomic Experience: Taste Afyon's famous *sucuk* (spiced sausage) and local delicacies.

Afternoon:

• Historic Mansions and Ulu Mosque: Explore Ottoman-era architectural gems.

• Afyonkarahisar Museum: Visit a museum showcasing historical and cultural collections.

Evening:

• **Return to Balıkesir:** Head back to Balıkesir in the evening.

This itinerary offers a rich experience for cultural and gastronomy enthusiasts, combining history and flavors. Travelers can enhance their journey with local guides or explore at their own pace. Comfortable transportation and high-quality accommodations will make the trip even more enjoyable.

ChatGPT	× +		- 0 ×		
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C Q C	ChatGPT ~		t Paylas B		
Scholar GPT		Balikesir ilinde yaşayan, kültür ve gastronomi turümine meraklı, aynı zamanda müzeleri gezmeyi seven bir aile için Balıkesir ili dışında farklı seyahat alternatifieni de değerlendireti bütçe kısıtı olmadan üç günlük bir tatil rotası oluşturur musun?			
Bugün					
Balikesir dışı tatil rotası 🛛 …	8	Elbettel Balıkesir'deki bir ailenin kültür ve gastronomi turizmiyle ilgilendiğini göz önünde bulundurarak, bütçe kısıtlaması olmaktızın üç günlük bir tatil rotası oluşturuyorum. Bu rota, tarihi ve kültürel zenginlikler, gastronomi deneyimleri ve müze gezileriyle dolu, Balıkesir dışındaki yerleri kapısyor:			
		1. Gün: İzmir - Tarih ve Lezzet Sabah:			
		Keyifli bir kahvaltı: İzmir'in ünlü kahvaltı mekanlarından birinde serpme kahvaltı (Öneri: Urla'daki			
		bir bağ oteli ya da Alsancak'ta yerel bir kafe).			
		Tarihi Kemeraltı Çarşısı: İzmir'in tarihi çarşısını keşfedin. Kızlarağası Hanı'nda kahve molası verin.			
		Öğle:			
		Gastronomi: İzmir mutfağından boyoz, kumu veya şevketibostan gibi yerel tatları deneyin.			
		Öğleden sonra:			
		ChatGPT uygulamasına ileti gönder			
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Image 1: ChatGPT Question-Answer Screen					
	(https://chatgpt.com/	c/675d7b71-35c8-800c-9fff-301be2ce97	′f0)		

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Google Gemini

3-Day Luxury Travel Itinerary for a Culture and Gastronomy Enthusiast Family Departing from Balikesir

After experiencing the beauty of Balıkesir, a family looking to immerse themselves in a different atmosphere can explore this carefully curated itinerary that blends cultural richness, natural wonders, and diverse culinary delights. This route offers the charm of ancient cities, the tranquility of nature, and the pleasure of unique flavors.

Day 1: Istanbul – A City Where History Meets Modernity

• Morning: Arrival in Istanbul and breakfast at a café in the historic peninsula.

• Noon: Visit the Hagia Sophia Museum to witness one of the most significant examples of Byzantine and Ottoman architecture.

• Afternoon: Explore the grandeur of Ottoman sultans at Topkapi Palace.

• **Evening:** Enjoy a **Bosphorus cruise**, taking in Istanbul's stunning views while savoring traditional Turkish cuisine.

• **Night:** Experience the city's vibrant nightlife with dinner at a fine restaurant in Beyoğlu.

Day 2: Cappadocia – The Enchantment of Fairy Chimneys and Underground Cities

- **Morning:** Flight to Cappadocia and check-in at your hotel.
- Noon: Visit Göreme Open-Air Museum and get lost among the fairy chimneys.
- Afternoon: Explore one of the underground cities and learn about prehistoric life.

• **Evening:** Enjoy a **wine tasting experience** featuring local Cappadocian wines, followed by a dinner of regional specialties.

• Night: Take a hot air balloon ride for a breathtaking aerial view of Cappadocia's surreal landscapes. *(Extra cost applies.)*

Day 3: Ephesus – A Time Travel Through Ancient Ruins

• Morning: Arrival at Ephesus Ancient City, visiting the Temple of Artemis, Celsus Library, and other iconic structures.

• Noon: Walk through the historic streets of Ephesus and take a break at the grand ancient theater.

• Afternoon: Discover the charm of Şirince, a picturesque village with stone houses and an authentic atmosphere.

- **Evening:** Travel to **Izmir** for a seafood dinner at a renowned restaurant.
- **Night:** Return flight from Izmir.

Additional Recommendations:

- Museums: Cappadocia Museum, Ephesus Museum
- Outdoor Activities: ATV safari, trekking, paragliding
- Gastronomy: Pigeon stew in Cappadocia, Boyoz in İzmir
- **Shopping:** Grand Bazaar in Istanbul, handwoven carpets in Cappadocia, homemade jams and spices in Şirince

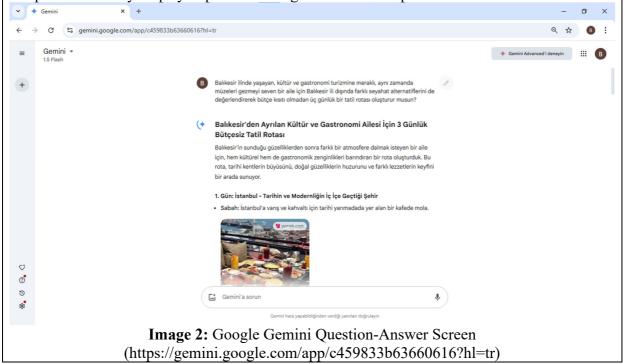
This itinerary is just a suggestion and can be customized according to your preferences and interests.

For a More Personalized Experience, Please Answer These Questions: Are you more interested in historical sites or natural landscapes?



- What type of **cuisine** do you prefer?
- Do you have a **specific budget range** in mind?

• Do you have any special interests (e.g., photography, hiking, adventure sports)? I hope this itinerary helps you plan an unforgettable travel experience!



3- Microsoft Copilot

3-Day Travel Itinerary for a Family Interested in Culture, Gastronomy, and Museums – Starting from Balikesir

This itinerary is designed for a family passionate about cultural and gastronomic tourism, as well as exploring museums. It offers a blend of historical sites, culinary delights, and natural beauty.

Day 1: Ayvalık

• Morning: Take a walking tour through the historic streets of Ayvalık and visit the Ayvalık Museum.

• Afternoon: Head to Cunda Island, explore its small churches and historical houses.

• **Evening:** Enjoy a delicious dinner at one of Ayvalık's seaside restaurants with stunning views.

Day 2: Edremit

• **Morning:** Visit the **thermal springs of Edremit** and learn about their historical and health significance.

• Afternoon: Explore Edremit Castle and immerse yourself in its historical ambiance.

Evening: Dine at one of Edremit's renowned restaurants, savoring local delicacies.

Day 3: Burhaniye



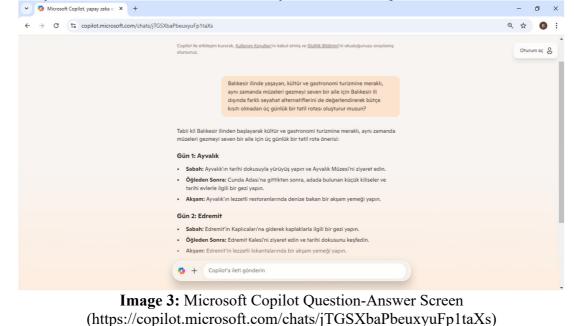
Morning: Travel to Burhaniye and visit the Burhaniye Museum.

• Afternoon: Discover the surrounding natural areas of Burhaniye and enjoy a relaxing picnic.

• Evening: Conclude your trip with a delightful dinner at a local restaurant in Burhaniye.

This itinerary allows you to explore the **cultural and gastronomic treasures** of Balıkesir while enjoying its museums and scenic beauty.

Would you like me to customize the itinerary further or add specific details?



4- Claude AI

3-Day Cultural and Gastronomic Travel Itinerary for a Museum-Loving Family from Balikesir

For a family residing in Balıkesir who enjoys cultural and gastronomic tourism as well as visiting museums, I have designed an exciting three-day travel itinerary. This plan highlights the region's rich cultural heritage and beautiful destinations, offering an unforgettable experience.

Day 1: İzmir and Surroundings

- Early Morning: Departure from Balıkesir to İzmir.
- **Breakfast & Strolling:** Enjoy breakfast and explore the historic **Kemeraltı Bazaar**.
- Museum Visit: Explore the İzmir Museum, featuring an extensive archaeological collection.
- Sightseeing: Visit Konak Square and the Clock Tower.
- Lunch: Sample traditional İzmir cuisine, including *kumru* sandwiches and fresh seafood.

• Afternoon: Ephesus Ancient City (UNESCO World Heritage Site)

- Marvel at its **stunning historical ruins**.
- Discover impressive Roman-era architectural structures.

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•	Şirince Village Visit:
0	Enjoy a wine tasting experience .
0	Admire the traditional Greek architecture.
0	Explore local artisanal products.
•	Evening: Overnight stay in Selçuk.
Day 2:	Muğla and Bodrum
•	Morning: Departure from Selçuk to Muğla/Bodrum.
•	Cultural Experience:
0	Visit Bodrum Castle and the Museum of Underwater Archaeology.
0	Explore the ancient Yumuk Tepe settlement.
0	Stroll through Bodrum's charming streets and admire the traditional white
houses	
•	Gastronomic Delights: Savor the richness of Turkish cuisine, including:
0	Çökertme kebabı
0	Olive oil-based Aegean dishes
0	Fresh seafood specialties
•	Evening: Dine in Bodrum's historic district and stay overnight in Bodrum.
Day 3:	Canakkale and Troy
•	Morning: Departure from Bodrum to Çanakkale.
•	Historical Exploration:
0	Visit Troy Ancient City (UNESCO World Heritage Site) to explore the
legend	ary Trojan War and its myths.
0	Discover the Gallipoli Historical Peninsula, including battlefields and
memor	
0	Tour the Çanakkale Military Museum to gain insight into the region's
history	
•	Culinary Experience: Taste local delicacies from Çanakkale, such as:
0	Çanakkale cheese
0	Turkish delight (lokum)
0	Çanakkale cherries
•	Evening: Rest and prepare for the return journey to Balıkesir.
Trave	Details:
•	Transportation: Private car or rental vehicle.
•	Accommodation: 4-5 star hotels or historic boutique accommodations.
•	Flexible dates based on seasonal preferences.
Additi	onal Recommendations:
•	Museum Pass: Consider purchasing a museum card for discounted entry.
•	Guided Tour Options: Enhance your experience with professional guides.
•	Seasonal Packing: Prepare appropriate clothing and gear based on the travel season.
This it	inerary offers a high-quality and comfort-focused experience for families passionate
	culture and gastronomy, with no budget constraints. It promises an enriching journey
	with history, flavors, and cultural treasures.

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5- Perplexity AI

3-Day Travel Itinerary for a Family in Balıkesir Interested in Culture and Gastronomy For a family living in Balıkesir who enjoys cultural and gastronomic tourism, various destinations across Turkey offer rich experiences. This carefully curated itinerary explores different regions, combining history, local flavors, and vibrant traditions.

Day 1: Istanbul – A Cultural Exploration

Morning:

• **Topkapi Palace:** The administrative center of the Ottoman Empire, this palace offers a fascinating start to the journey with its rich history and stunning architecture. It is recommended to book tickets and guided tours in advance. **Lunch:**

• Sultanahmet Square: Enjoy a meal at one of the restaurants serving traditional Turkish cuisine. Specialties such as kebabs and mezze are highly recommended.

Afternoon:

• **Hagia Sophia:** A breathtaking structure from the Byzantine era, known for its impressive architecture and historical significance. After the visit, enjoy a tea or coffee break at a nearby café.

Evening:

• **Grand Bazaar:** Shop for traditional handicrafts and souvenirs. For dinner, explore restaurants around the Grand Bazaar offering authentic Turkish dishes.

Day 2: Edirne – Gastronomy and History Morning:

• Selimiye Mosque: A masterpiece by Mimar Sinan and an iconic symbol of Edirne. After the visit, explore nearby historical sites. **ASIA PACIFIC** 11th INTERNATIONAL CONGRESS ON CONTEMPORARY SCIENTIFIC RESEARCH March 12-15, 2025 / Ho Chi Minh, Vietnam WEB: https://www.iksadasia.org/ E-MAIL: iksadasia@gmail.com

Lunch:

• Edirne Fried Liver (*Tava Ciğeri*): A must-try local delicacy, best enjoyed at one of Edirne's famous restaurants.

Afternoon:

• Edirne Palace and Archaeology Museum: Gain insight into the rich history of Edirne through its collection of artifacts and historical exhibits. Evening:

• Kırkpınar Oil Wrestling Museum: If time allows, visit this museum to learn about the history of traditional Turkish wrestling. For dinner, try grilled meatballs or liver kebab at a local restaurant.

Day 3: Bursa – Nature and Culture

Morning:

• Uludağ National Park: Ideal for nature walks and outdoor activities. In winter, visitors can enjoy skiing and other winter sports.

Lunch:

• Bursa İskender Kebab: A visit to Bursa is incomplete without trying its famous Iskender kebab at a well-known local restaurant.

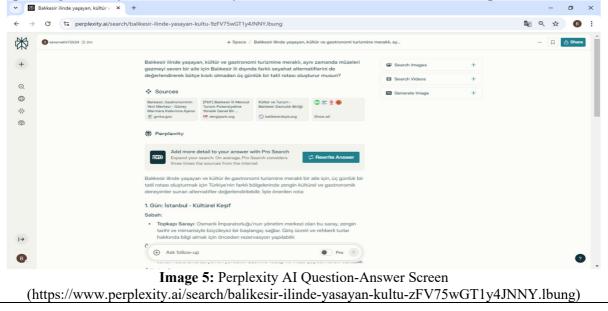
Afternoon:

• Green Tomb and Grand Mosque (*Ulu Camii*): Explore the architectural wonders of Ottoman heritage, offering insight into Bursa's historical significance.

Evening:

• Shopping and Dessert in Bursa's Bazaar: Stroll through the bazaar, shop for souvenirs, and indulge in chestnut candies (*kestane şekeri*) or Bursa's famous profiterole before heading back home.

This itinerary provides a perfect mix of **cultural**, **historical**, **and gastronomic experiences**, making it an exciting journey for a family interested in discovering Turkey's rich heritage. Spending each day in a different city allows for a diverse and immersive experience.





The responses provided by the chatbots above have been presented as they are, without any modifications. In line with the purpose of the study, a comparative table has been created to assess the chatbots' ability to plan tour routes and their suitability for user needs.

	CHATGPT	GOOGLE	MICROSOFT	CLAUDE AI	PERPLEXITY
		GEMINI	COPILOT		AI
DAY 1	Kemeraltı Bazaar	Historic Peninsula	Ayvalık	Kemeraltı	Topkapı Palace
ITINERARY	(İzmir)	(Istanbul)		Bazaar (İzmir)	(Istanbul)
PLAN	Kızlarağası Han	Hagia Sophia	Ayvalık	İzmir Museum	Sultanahmet
	÷ ·	Museum	Museum	K 1 0	Square
	İzmir Archaeology	Topkapı Palace	Cunda Island	Konak Square & Clock Tower	Hagia Sophia
	Museum			a clock Tower	
	Ahmet Piriștina	_	-	Ephesus	Grand Bazaar
	City Archive and			Ancient City	Grund Duzuur
	Museum			(UNESCO Site)	
	Alsancak Kordon	-	-	Şirince Village	-
DAY 2	Pamukkale	Cappadocia	Edremit	Bodrum Castle	Selimiye
ITINERARY	(Denizli)		Thermal		Mosque
PLAN			Springs		(Edirne)
	Pamukkale	Göreme Open-Air	Edremit Castle	Museum of	Edirne Palace
	Travertines	Museum		Underwater	& Archaeology
	Hierapolis	Underground Cities	-	Archaeology Ancient Yumuk	Museum Kırkpınar Oil
	Ancient City	Onderground Chies	-	Tepe Settlement	Wrestling
	Therefit City			repe settlement	Museum
	Hierapolis	-	-	-	-
	Archaeology				
	Museum				
	1.0		D 1 '	T	T T1 1 ~
DAY 3	Afyon	Ephesus Ancient	Burhaniye	Troy Ancient	Uludağ
ITINERARY	Afyon	Ephesus Ancient City	Burhaniye Museum	City (UNESCO	National Park
		City	Museum	City (UNESCO Site)	National Park (Bursa)
ITINERARY	Afyon Afyon Castle		=	City (UNESCO Site) Gallipoli	National Park (Bursa) Green Tomb &
ITINERARY		City	Museum	City (UNESCO Site) Gallipoli Historical	National Park (Bursa)
ITINERARY	Afyon Castle	City	Museum	City (UNESCO Site) Gallipoli Historical National Park	National Park (Bursa) Green Tomb &
ITINERARY		City	Museum	City (UNESCO Site) Gallipoli Historical	National Park (Bursa) Green Tomb & Grand Mosque
ITINERARY	Afyon Castle Victory Museum	City	Museum	City (UNESCO Site) Gallipoli Historical National Park Çanakkale	National Park (Bursa) Green Tomb & Grand Mosque
ITINERARY	Afyon Castle Victory Museum Historic	City	Museum	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military	National Park (Bursa) Green Tomb & Grand Mosque
ITINERARY	Afyon Castle Victory Museum Historic Mansions &	City	Museum Burhaniye	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar
ITINERARY	Afyon Castle Victory Museum Historic Mansions & Grand Mosque	City	Museum Burhaniye	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar
ITINERARY	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar	City	Museum Burhaniye	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar
ITINERARY	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar Museum	City Şirince Village - - -	Museum Burhaniye	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military Museum -	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar -
ITINERARY	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar	City	Museum Burhaniye	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar
ITINERARY PLAN	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar Museum	City Şirince Village - - -	Museum Burhaniye	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military Museum - - Private/Rental	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar -
ITINERARY PLAN MEANS OF	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar Museum Car High-Speed Train Traditional	City Şirince Village - - Flight - Breakfast in the	Museum Burhaniye - - - Unspecified - Walking tours,	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military Museum - - Private/Rental Car - Breakfast at	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar - - - Unspecified - Lunch in
ITINERARY PLAN MEANS TRANSPORT OF	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar Museum Car High-Speed Train Traditional breakfast, coffee	City Şirince Village - - - Flight - Breakfast in the Historic Peninsula,	Museum Burhaniye - - - Unspecified - Walking tours, visits to	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military Museum - - Private/Rental Car - Breakfast at Kemeraltı	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar - - - - Unspecified - Lunch in Sultanahmet,
ITINERARY PLAN MEANS TRANSPORT OF	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar Museum Car High-Speed Train Traditional breakfast, coffee break, sunset	City Şirince Village - - - Flight - Breakfast in the Historic Peninsula, Bosphorus cruise,	Museum Burhaniye - - - Unspecified - Walking tours, visits to churches &	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military Museum - - Private/Rental Car - Breakfast at Kemeraltı Bazaar,	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar - - - Unspecified - Lunch in Sultanahmet, coffee breaks,
ITINERARY PLAN MEANS TRANSPORT OF	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar Museum Car High-Speed Train Traditional breakfast, coffee	City Şirince Village - - - Flight - Breakfast in the Historic Peninsula, Bosphorus cruise, exploring Turkish	Museum Burhaniye - - - Unspecified - Walking tours, visits to churches & historical	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military Museum - - Private/Rental Car - Breakfast at Kemeraltı Bazaar, museum visits,	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar - - - - Unspecified - Lunch in Sultanahmet,
ITINERARY PLAN MEANS TRANSPORT OF	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar Museum Car High-Speed Train Traditional breakfast, coffee break, sunset	City Şirince Village - - - Flight - Breakfast in the Historic Peninsula, Bosphorus cruise,	Museum Burhaniye - - - Unspecified - Walking tours, visits to churches &	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military Museum - - Private/Rental Car - Breakfast at Kemeraltı Bazaar, museum visits, ancient city	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar - - - Unspecified - Lunch in Sultanahmet, coffee breaks,
ITINERARY PLAN MEANS TRANSPORT OF	Afyon Castle Victory Museum Historic Mansions & Grand Mosque Afyonkarahisar Museum Car High-Speed Train Traditional breakfast, coffee break, sunset	City Şirince Village - - - Flight - Breakfast in the Historic Peninsula, Bosphorus cruise, exploring Turkish	Museum Burhaniye - - - Unspecified - Walking tours, visits to churches & historical	City (UNESCO Site) Gallipoli Historical National Park Çanakkale Military Museum - - Private/Rental Car - Breakfast at Kemeraltı Bazaar, museum visits,	National Park (Bursa) Green Tomb & Grand Mosque Bursa Bazaar - - - Unspecified - Lunch in Sultanahmet, coffee breaks,

Table 1. Comparison of Travel Itineraries Generated by AI-Assisted Chatbots

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	Walk through Pamukkale travertines, thermal pool experience	Wine tasting, trying local delicacies, hot air balloon ride	Thermal bath experience	Exploring Bodrum's historic houses & streets, tasting local cuisine	Mosque & museum visits, culinary experiences
	City view from Afyon Castle	Walking tours	Exploring nature & local cuisine	Exploring Troy War history, trying local delicacies	Skiing, tasting regional dishes
LOCAL CUISINES	Boyoz, Kumru, Şevketibostan	Boyoz	Not specified	Kumru, fresh seafood, Şirince wine	Kebabs & mezze
	Denizli kebab	-	-	Çökertme kebab, olive oil dishes, seafood	Edirne fried liver, meatballs, liver kebab
	Afyon cream & sausage	Cappadocia wines, pigeon stew	-	Çanakkale cheese, Turkish delight, cherries	İskender kebab, chestnut dessert, profiterole
ADDITIONAL SUGGESTIONS	Hiring local guides, ensuring comfortable transport & quality accommodation	Museumvisits, activities, gastronomy&gastronomy&shoppingsuggestions, necessityaseparatebudgetfor transportation, accommodation, food & activities	Not specified	Purchasing a museum card, guided tours, seasonal clothing preparation	Advance booking for entrance fees & guided tours

According to Table 1, while the four AI-powered chatbots generated different three-day travel itineraries outside the Balıkesir province as requested, Microsoft Copilot focused on planning a trip within the districts of Balıkesir. Although the question did not impose a budget constraint, considering time and budget limitations, its response can be regarded as userfriendly. However, it was observed that this chatbot provided relatively brief responses with limited details. From this perspective, it can be argued that it is less effective in generating personalized travel plans for users. On the other hand, ChatGPT and Claude AI notably started their itineraries on the first day at Izmir's Historic Kemeraltı Bazaar and then focused on different locations in Izmir. Similarly, Google Gemini and Perplexity AI initiated their itineraries from Istanbul on the first day and included similar destinations in their plans, which is another noteworthy detail. When the itineraries planned by the AI-Assisted chat robots used in this study were analyzed as a whole, ChatGPT, Microsoft Gemini, Claude AI, and Perplexity AI presented rich in detail travel programs. Moreover, the data they provided about local cuisines in the visited destinations was especially remarkably. In terms of recommendations, it was observed that only Microsoft Copilot was did not provide any suggestions.



RESULTS

Artificial intelligence (AI) assisted chat robots hold potential to improve user experience during the tour route planning process. By offering personalized suggestions these technologies make it possible to design itineraries that specific to the requirements and tastes of users. The study findings shows that AI-Assisted chat robots can serve as an useful tool when it comes to planning a tour itinerary progress. Although these itineraries may appear satisfactory by encompassing multiple destinations and offering a range of activities, it is clear that there are some practical issues in terms of feasibility, particularly concerning time and transportation. Supporting that it has been observed that these plans are lack clear transportation-related information. Consequently, while this might necessitate users to make additional efforts during the planning phase, it also emphasizes the necessity for users to interact with chatbots to inquire about transportation, accommodation, and other relevant aspects, so that enabling them to effectively customize their tour plans.

In summary, even though AI-supported chatbots introduce a significant innovation in the tour route planning process, the effective utilization of these systems needs more advanced algorithms and exhaustive data integration. In the future, additional developments in these technologies, may enable them to respond more accurately to user needs, could make travel planning both easier and more enjoyable. Accordingly, various suggestions can be proposed.

First of all, it is vital to further developments of natural language processing (NLP) algorithms to assure that AI-Assisted chat robots accurately understand and respond to user needs conveyed in natural language. In this context, language models should be improved to be more sensitive to content and trained to take cultural variations into account. Moreover, for AI-Assisted chat robots to provide more comprehensive and consistent tour route recommendations, they must be integrated with diverse data sources, such as transportation networks, weather forecasts, current events, and reservation platforms. Furthermore, systematic user feedback collection, analysis and implementation should be given top priority in order to support ongoing improvements and increase the efficacy of these chat robots. These improvements may result in a more tailored and fulfilling user experience, which would ultimately increase the efficacy and uptake of AI-Assisted chat robots.

The limitation of this study is that it was conducted using only five AI-Assisted chat robots. Future studies may broad the focus by examining other AI-powered chatbots and performing comparative analyses that considering various criterias such as different regions, budgets, types of tourism, number of participants, demographic characteristics, and modes of transportation.

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AI-Assisted Chat Robots Used in the Study

ChatGPT: https://chatgpt.com/c/675d7b71-35c8-800c-9fff-301be2ce97f0 Google Gemini: https://gemini.google.com/app/c459833b63660616?hl=tr Microsoft Copilot: https://copilot.microsoft.com/chats/jTGSXbaPbeuxyuFp1taXs Claude AI: https://claude.ai/chat/acb89dda-c719-46e0-830d-39711ce886f0

Perplexity AI: https://www.perplexity.ai/search/balikesir-ilinde-yasayan-kultu-zFV75wGT1y4JNNY.lbung

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YAPAY ZEKÂ VE İNSAN HAKLARI

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ÖZET

İnternet, elektronik cihazlar, arama motorları ve farklı çevrimiçi platformlarda dahil olmak üzere dijital mimarinin bir parçası olan yapay zekâ yaşamımızın birçok alanında yer almakta ve hayatımıza etkisi giderek artmaya devam etmektedir. Yapay zekâ yaşamımızın yanı sıra insan haklarını da etkilemekte ve hak ve özgürlüklerden yaralanmada bir yandan önemli fırsatlar sunarken, diğer yandan birtakım riskler de gündeme gelmektedir.

Yapay zekâ uygulamaları zengin veri ve bilgi kaynaklarına erişimi ve bilimsel araştırmaları geliştirmesiyle başta eğitim hakkı olmak üzere çeşitli sosyal, kültürel ve ekonomik hakların kullanılmasını kolaylaştırmaktadır. Ayrıca başarılı modeller ve en iyi uygulama örneklerini yaygınlaştırarak insan hakları farkındalığının artırılmasına da çok önemli katkı sağlayabilmektedir.

Öte yandan, birçok yapay zekâ uygulaması insani liderlik, mevzuat düzenlemeleri ve hukuki hesap verebilirlikten kaçınabilmekte olduğundan insan hakları normları ve standartları için ciddi zorluklar ve tehditler de oluşturmaktadır. Örneğin, bazı sistemlerin sosyal kesimleri belirlemek için kullandığı veri ve algoritmalar, dezavantajlı gruplar için eşitsizlik ve dışlanmaya katkıda bulunabilir. Bu tür metodolojik ayrımcılık modelleri sosyal kesimlerin görüşlerinin sınırlandırılması ve kişisel bilgilerin kötüye kullanılması gibi hem medeni ve siyasi haklar hem de ekonomik, sosyal ve kültürel açısından ciddi riskler ortaya çıkarmaktadır.

Yapay zekâ uygulamalarının hızlı gelişimi mevcut uluslararası ulusal insan hakları mekanizmalarını söz konusu konunun nasıl ele alınacağı konusunda benzeri görülmemiş bir zorlukla karşı karşıya bırakmıştır. Ortaya çıkan bu teknolojik gerçeklik, yapay zekanın farklı insan haklarına yönelik oluşturduğu potansiyel tehditleri azaltmak için yeni ve uygun mekanizmalar gerektirmektedir. Bu kapsamda son dönemde yapay zekanın tetiklediği hızlı gelişime ayak uydurmak için insan haklarına yönelik normatif çerçevenin geliştirilmesine yönelik uluslararası çabalar hız kazanmıştır.

Bu kapsamda Birleşmiş Milletler İnsan Hakları Konseyi, 53. oturumunda (Temmuz 2023), uluslararası toplumu yapay zekâ ile ilgili sistemlerinin şeffaflığının arttırılması ve bu teknolojiye tahsis edilen verilerin insan haklarına uygun yöntemlerle toplanması, kullanılması, paylaşılması, saklanması ve silinmesinin sağlanması çağrısında bulunan önleyici ve denetleyici tedbirleri içeren tavsiye niteliğinde bir kararı oybirliğiyle kabul etmiştir.

Avrupa Konseyi yapay zekanın insan hakları, demokrasi ve hukukun üstünlüğüne ilişkin ortak standartları desteklemesini sağlamak ve risklerini en aza indirmek amacıyla ilk uluslararası sözleşme olan Yapay Zekâ ve İnsan Hakları, Demokrasi ve Hukukun Üstünlüğüne Dair Avrupa Konseyi Çerçeve Sözleşmesi'ni hazırlamış, Sözleşme 5 Eylül 2024 tarihinde imzaya açılmıştır. Avrupa Birliği ise yapay zekâ ile ilgili olarak 12 Temmuz 2024 tarihinde yürürlüğe giren 2024/1689 No.lu Direktifi kabul etmiştir.

Tüm bu çalışmalarda yapay zekanın tasarımı, geliştirilmesi ve kullanımı için geçerli olan insan hakları standartları ile tasarım ve kullanımının uluslararası insan hakları hukukuna uygun olmasını sağlamada devletin sorumlulukları ve özel şirketlerin rolü gündeme gelmektedir.



Sunumda yapay zekanın temel kavram ve ilkeleri ile normatif ve yasal çerçeveler oluşturmak için devam eden uluslararası çalışmalar hakkında bilgiler verilecektir. Daha sonra ise yapay zekâ uygulamalarının insan haklarının kullanılmasına ilişkin oluşturduğu riskleri minimize etmek ve ortadan kaldırmak için devletler başta olmak üzere uluslararası toplum ve diğer paydaşlar tarafından alınması gereken tedbirlere ilişkin çözüm önerilerinde bulunulacaktır. **Anahtar Kelimeler:** Yapay Zekâ, İnsan Hakları, Devletin Sorumlulukları, Avrupa Konseyi Çerçeve Sözleşmesi, Avrupa Birliği Direktifi, BM İnsan Hakları Konseyi Kararı

ARTIFICIAL INTELLIGENCE AND HUMAN RIGHTS

ABSTRACT

Artificial intelligence (AI), which is a part of the digital architecture, including the Internet, electronic devices, search engines and different online platforms, is present in many areas of our lives and its impact on our lives increases continuesly. AI affects human rights as well as our lives, and while it offers important opportunities in the enjoyment of rights and freedoms, it also poses certain risks.

AI applications facilitate the exercise of various social, cultural and economic rights, especially the right to education, by improving access to rich data and information sources and scientific research. They can also make a significant contribution to raising awareness of human rights by disseminating successful models and best practices.

On the other hand, many AI applications also pose serious challenges and threats to human rights norms and standards, as they can avoid human leadership, regulation and legal accountability. For example, the data and algorithms that some systems use to identify social segments can contribute to inequality and exclusion for disadvantaged groups. Such patterns of methodological discrimination pose serious risks to civil and political rights, as well as to economic, social and cultural rights, such as the limitation of the views of social groups and the misuse of personal information.

The rapid development of AI applications has presented existing international national human rights mechanisms with an unprecedented challenge in how to address this issue. This emerging technological reality requires new and appropriate mechanisms to mitigate the potential threats posed by AI to different human rights. In this context, international efforts to develop a normative framework for human rights to keep pace with the rapid development triggered by AI have recently gained momentum.

In this context, the United Nations Human Rights Council, at its 53rd Session (July 2023), unanimously adopted a recommendatory resolution on preventive and supervisory measures calling on the international community to increase the transparency of systems related to AI and to ensure that data allocated to this technology are collected, used, shared, stored and deleted in ways that are compatible with human rights.

The Council of Europe drafted the Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law, the first international convention to ensure that AI supports common standards on human rights, democracy and the rule of law and to minimize its risks. The Convention opened for signature on 5 September 2024. The European Union adopted Directive 2024/1689 on AI, which entered into force on July 12, 2024.

All these efforts raise the issue of human rights standards applicable to the design, development and use of AI, and the responsibilities of the state and the role of private companies in ensuring that its design and use comply with international human rights law.



The presentation will introduce the basic concepts and principles of AI and the ongoing international efforts to establish normative and legal frameworks. It will then propose solutions on the measures that should be taken by the international community and other stakeholders, especially states, to minimize and eliminate the risks posed by AI applications regarding the exercise of human rights.

Keywords: Artificial Intelligence, Human Rights, State Responsibilities, Council of Europe Framework Convention, European Union Directive, UN Human Rights Council Resolution



THE EFFECT OF PERCEIVED RISKS IN CONTENT PRODUCTION WITH ARTIFICIAL INTELLIGENCE ON CONSUMERS' ATTITUDES AND BEHAVIORAL INTENTIONS

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Abstract

Artificial intelligence technologies make our lives easier, but they also have many drawbacks for users. In the literature, many studies have focused on the positive contributions of artificial intelligence, but studies on the impact of the risks perceived by consumers on their behaviour have remained at a limited level. In this direction, the aim of the study is to investigate the effect of perceived risks (performance, time, privacy, financial, psychological, social, security, sustainability, social, security, sustainability) on consumers' attitudes and behavioural intentions in producing content with artificial intelligence. In the study, data were collected from 343 users who produced content with artificial intelligence. SPSS 22 and AMOS 24 software packages were used to analyse the data obtained. Confirmatory factor analysis and path analysis were used to evaluate the data. As a result of the study, it was revealed that the time, privacy, psychological, social, security and sustainability risks perceived by users while producing content with artificial intelligence significantly affect their attitudes. In addition, users' attitudes towards artificial intelligence positively affect their behavioural intentions. Therefore, reducing the perceived risks while producing content with artificial intelligence will enable users to use this technology more comfortably and effectively.

Keywords: Artificial Intelligence, Percieved Risk, Sustainability, Privacy/Security, SEM

1- INTRODUCTION

Artificial Intelligence (AI) can be defined as a set of theories and algorithms by which computer systems can perform tasks that require human intelligence, such as visual recognition, text interpretation and visual perception (Wang & Wang, 2022). Recently, artificial intelligence technologies that can even surpass human intelligence have started to be developed. In fact, for the first time in the history of the world, it has been stated that a system can process information better than human intelligence (Yilmaz, Yilmaz & Ceylan, 2024). Thanks to these features, artificial intelligence users can solve their jobs faster and easier. Even artificial intelligence systems can support consumer decision-making processes (Kelly, Kaye & Oviedo-Trespalacios, 2023). Due to the use of artificial intelligence for many factors (such as work, health, sports, home life, etc.) and the information obtained from consumers, concerns in this direction are also increasing (Giudici, Centurelli & Turchetta, 2024). Therefore, concerns about artificial intelligence are also increasing with this information and newly developed artificial intelligence models. Although the first information about artificial intelligence emerged in the 1950s, developments in the last five years have made people more concerned about this issue (Schuett, 2024). Although risk perceptions differ among individuals, negative feelings in this direction are increasing. Although users accept a certain level of risk when they disclose personal information to companies, some consumers may not clearly understand how companies use their data.



The ability of many AI technologies to direct consumer preferences has been demonstrated by research (Kovacova, Machova & Bennett, 2022). Amazon company can reveal the products that users can buy on a day and hour basis based on their data. Netflix can personalise series/movie recommendations by evaluating users' past viewings (Ramadan, Farah & El Essrawi, 2021). Social media applications such as Instagram and Tiktok also integrate artificial intelligence applications into their content (Singh, 2021). One of the most remarkable artificial intelligence applications is ChatGPT. Developed by OpenAI, ChatGPT is a chatbot powered by a large language model (LLM) using deep learning and natural language processing (NLP) techniques (Lee, Lee & Cha, 2023). Since its launch in 2022, ChatGPT has rapidly gained widespread popularity, reaching more than 100 million users within two months. Although the number of users today is expressed in millions, it is predicted that much more users will be reached in the future (George, & George, 2023). ChatGPT, which uses artificial intelligence technologies, is one of the leading companies in this field. Therefore, it is also the centre of research on artificial intelligence. Although the advantages of ChatGPT are more prominent in the researches conducted in this direction, reservations about ethics, privacy and reliability are also increasing. Research conducted in this direction (Schwesig et al., 2023; Rohden & Zeferino, 2023; Al Murshidi et al., 2024; Bhaskar et al., 2024; Hwang et al., 2024) clearly reveals these concerns.

Schwesig et al. (2023) examined users' risk-benefit assessments for the use of artificial intelligence. As a result of the study, it was seen that risk-taking behaviour is important in creating opportunities and people's use of artificial intelligence applications. Rohden & Zeferino (2023) analysed consumers' risk perceptions towards artificial intelligence in their study. As a result of the research, it was revealed that consumers are generally unaware of the working system of recommendation agents. This situation causes them to be unsure about the usability and purpose of artificial intelligence. Al Murshidi et al. (2024) investigated the limitations and risks of using ChatGPT. As a result, a positive relationship was found between awareness of limitations and intention to use ChatGPT. In addition, awareness of risks was found to be positively related to the intention to use ChatGPT. Bhaskar et al. (2024) investigated the effect of ChatGPT use on teachers. As a result of the research, they found that perceived risk showed a negative moderator effect between perceived benefit and adoption intention and between perceived trust and adoption intention. Hwang et al. (2024) examined face recognition technology with artificial intelligence within the scope of perceived risk theory and theory of planned behaviour. As a result of the study, they found that privacy and psychological risks are effective on people's attitudes.

Although studies on perceived risks in artificial intelligence have been conducted in recent years, studies on the behaviour of individuals are quite limited. In addition, perceived risk has not been addressed with its subcomponents in many studies, so it has not been determined which risks are more effective in producing content with artificial intelligence. Accordingly, this study will address this gap and examine the impact of performance, time, privacy, financial, psychological, social, security, sustainability, social, security and sustainability risks on consumers' attitudes and behavioural intentions in content creation with artificial intelligence (ChatGPT). This study will make two important contributions to the literature. Firstly, the risks considered within the scope of perceived risk theory will be expanded and the effect of social, security and sustainability risks on the use of artificial intelligence will be revealed. Thus, it will be possible to determine which measures should be taken by artificial intelligence producers and states. Secondly, consumers' attitudes and behavioural intentions with artificial intelligence will be revealed. Thus, it will be possible to determine which measures should be taken by artificial intelligence producers and states. Secondly, consumers' attitudes and behavioural intentions will also be measured when producing content with artificial intelligence.



Since attitudes cannot be easily changed in the long term, it will be possible to contribute to a safer AI experience by making evaluations on the basis of risks that affect the behaviour of users when producing content with the use of artificial intelligence. Thus, people will be able to use artificial intelligence applications in a more peaceful and effective way.

2- LITERATURE

Perceived risk theory has been used to explain the behaviour of consumers since the 1960s. In this process, many researchers have conducted research on purchasing behaviour (Pillai et al., 2022; Koay, Cheah & Lom, 2023), usage behaviour (Xie et al., 2021; Featherman et al., 2021) or consumer attitude (Palau-Saumell et al., 2021; Namahoot & Jantasri, 2023) by using this theory. While carrying out these studies, most researchers have stated that the risk perceived by consumers is a multidimensional structure. Within this, performance risk, time risk, privacy risk, financial and social risk have been frequently addressed in studies (Jacoby & Kaplan, 1972; Featherman & Pavlou, 2003; Choe, Kim & Hwang, 2021; Teng et al., 2022). In recent years, consumers have heard some risks in areas such as online purchasing behaviour, trust, financial technologies (fintech), electric cars, artificial intelligence. Therefore, research in this direction (Qalati et al., 2021; Liu, Zou & Greene, 2024; Sohn, 2024) is also increasing. In this study, the effect of the risks perceived by consumers on their attitudes and intentions in producing content with artificial intelligence will be investigated. Performance risk refers to losses due to deficiencies or malfunctions of artificial intelligence applications (Choe et al., 2021). For example, in the old versions of the ChatGPT programme, artificial intelligence could choose to answer a question it did not know, even if it was wrong, instead of not answering it. In addition, the content of the answers given by these programmes in their new versions may contain unconfirmed or incorrect information. The time risk arises from the loss of time and discomfort caused by the difficulty of obtaining information in artificial intelligence applications (Featherman et al., 2021). Time risk arises if participants feel that they spend too much time learning how to use these applications. Privacy risk refers to the concern that AI applications may not store the information obtained from users correctly or use this information for other purposes (Hwang et al., 2021). In this regard, the fact that some large digital businesses sell user information despite stating in their user agreements that it will not be shared with other institutions, organisations or third parties increases concerns in this direction. Since artificial intelligence applications can collect information from users at a much higher rate, the rate of concern on this issue increases much more. Financial risk refers to the risk that users will not get what they pay for artificial intelligence (Lee & Kim, 2023). This risk decreases for individuals who think that they can produce work in return for the amount paid for these programmes. Social risk is a type of risk that results in the negative evaluation of the use of artificial intelligence applications by the person's friends/family/work group (Hwang et al., 2024). A user who is evaluated negatively about the use of artificial intelligence may feel at risk by questioning this situation. In addition to these risk types, it is considered that the use of artificial intelligence also includes security, psychological and sustainability risks. Security risk refers to users' concerns about the disclosure of personal information while using these systems (Featherman et al., 2021). Artificial intelligence technologies can conduct a detailed research about the user on the internet, revealing information such as which subject he/she studies more, what kind of films he/she likes, his/her favourite team, and so on. Therefore, users may not feel safe in this regard. Psychological risk shows whether users are comfortable or more nervous when using these technologies (Hwang et al., 2021).

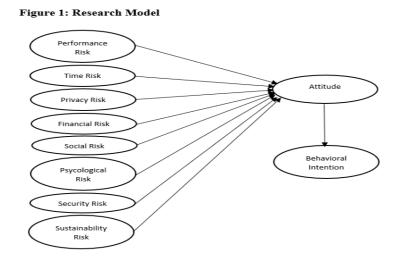


Psychological risk is high in individuals who feel discomfort, anxiety, and tension while using artificial intelligence. Finally, sustainability risk refers to the concern about the use of artificial intelligence due to the damage it causes to energy resources (Nobanee et al., 2021). According to International Energy Agency- IEA (2023) data, a ChatGPT query consumes 2.9 watt-hours of electricity, while a Google search causes 0.3 watt-hours of electricity consumption. Therefore, concerns in this direction also increase the sustainability risk. It is predicted that all these risks may negatively affect the attitudes of artificial intelligence consumers. In addition to these, the study investigated the effect of attitude on behavioural intention. The effect of attitude on behavioural intention and subsequent behaviour within the framework of the theory of planned behaviour has been revealed in many studies (Pillai et al., 2022; Tang, Han & Ng, 2023; Rūtelionė, & Bhutto, 2024). Therefore, in this study, the effect of attitude towards the use of artificial intelligence on behavioural intention will be investigated.

3- METHODOLOGY

In addition to the risk variables considered within the scope of perceived risk theory in the study, a model was created to determine the effect of social, security and sustainability risks on the attitudes and behavioural intentions of individuals in producing content with artificial intelligence (Figure 1). In line with this model, paths between variables will be revealed by structural equation modelling. In the study, data were collected from individuals who produce content with ChatGPT, one of the artificial intelligence applications. Therefore, purposive sampling was used. Individuals who did not use the artificial intelligence application were not included in the study.

Performance, time and privacy risks were measured with three items each and adapted from Hwang et al. (2024). Financial, social and psychological risks were measured with three items each and adapted from Crespo et al. (2009). Security risk was measured with 3 items and adapted from Lee (2009). Sustainability risk was measured with 4 items and adapted from Chowdhury & Quaddus (2021). Attitude was measured with 4 items and adapted from Wang et al. (2024). Behavioural intention was measured with 3 items using Li (2024) study. All items were measured using seven-point Likert scales, ranging from totally disagree (1) to totally agree (7).





For the number of questionnaires to be collected in the study, the sample size was calculated by power analysis with the G*Power programme (Kang, 2021). The analysis, with an alpha level of 0.01, yielded a sample size of 262 for a model with a statistical power of 0.99 based on a medium effect size ($f^2 = 0.15$). Accordingly, a total of 343 data were collected from the participants. 46.4% of the participants were women and 53.6% were men. The suitability of the data obtained in the study for structural equation modelling was tested for reliability and validity with preliminary analyses. Firstly, normality values were analysed. The skewness and kurtosis values obtained were found to be within the +1-1 limits (Demir, 2022). VIF values were analysed to test whether there was a multicollinearity problem among the variables. These values are also below 10 (Hair et al., 2021). Therefore, there is no multicollinearity problem. For reliability, composite reliability and cronbach alpha values were measured. As can be seen in Table 1, the values obtained are above 0.70 on a variable basis (Kennedy, 2022), so the scales are considered reliable. Confirmatory factor analysis was applied for construct validity. Factor loadings above 0.50 and AVE values above 0.5 were evaluated (Hair et al., 2021). AVE values ranging between 0.50 and 0.68 have larger values than the variance caused by measurement error. Therefore, convergent validity was achieved in the study. For discriminant validity, HTMT values were evaluated. In this approach, the HTML value is considered good when it does not exceed the threshold of 0.9 (Henseler et al., 2015). The values obtained in the study are presented in Table 2. The values obtained are below the threshold of 0.9. Therefore, discriminant validity was also achieved in the study.

Table 1. Multiconnearity, Renability and Valuity Statistics					
Dimension	C.A.	C.R.	AVE	VIF	
Performance R.	0.97	0.96	0.87	1.235	
Time R.	0.94	0.94	0.82	1.106	
Privacy R.	0.96	0.95	0.84	1.328	
Financial R.	0.93	0.94	0.83	1.274	
Social R.	0.93	0.92	0.81	1.165	
Psycological R.	0.96	0.96	0.86	1.193	
Security R.	0.88	0.87	0,75	1.486	
Sustainability R.	0.92	0.91	0,80	1.209	
Attitude	0.92	0.92	0,82	1.187	
Behavioral Intention	0.88	0.88	0,74	1.261	

Table 1: Multicollinearity, Reliability and Validity Statistics

*C.A.: Cronbach Alpa, C.R.: Composite Reliability, AVE: Average Variance Extracted, VIF: Variance Inflation Factor

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Dimensions*	1	2	3	4	5	6	7	8	9	10
1	-									
2	0,08	-								
3	0,42	0,16	-							
4	0,24	0,17	0,19	-						
5	0,05	0,14	0,18	0,07	-					
6	0,16	0,09	0,10	0,03	0,27	-				
7	0,12	0,08	0,23	0,12	0,20	0,03	-			
8	0,08	0,03	0,08	0,07	0,34	0,02	0,12	-		
9	-0,05	-0,23	-0,06	-0,03	-0,14	-0,16	-0,32	-0,09	-	
10	-0,25	-0,03	-0,31	-0,06	-0,07	-0,08	-0,08	-0,37	0,05	-

Table 2: HTMT Analysis

*1-Performance Risk, 2-Time Risk, 3-Privacy Risk, 4-Financial Risk., 5-Social Risk, 6-Psycological Risk, 7- Security Risk, 8-Sustainability Risk, 9-Attitude, 10-Behavioral Intention

4- FINDINGS

In the study, confirmatory factor analysis and path analysis were performed with AMOS 24 package programme. Thus, the links between multiple variables were revealed. In total, risks with 8 latent variables and dependent variables with 2 latent variables were analysed in content generation with artificial intelligence. As a result of confirmatory factor analysis, expected good fit values were obtained (Byrne 2001). The values obtained are $\chi 2$ =449.879, df =152, p<0.001, NFI =.951, CFI =.952, TLI =.950, RMSEA =.079, respectively. Therefore, construct validity was achieved. After confirmatory factor analysis, latent variables were transformed into observed variables and path analysis was performed. The obtained values were $\chi 2$ =22.765, df =17, GFI =.987, AGFI=.958, NFI= .955, TLI= .967, CFI= .987, RMSEA= .030 respectively. This is considered as excellent fit values (Hair et al., 2021). The obtained significant paths are presented in Table 3.

Path	В	S.E.	Р	Accepted/Rejected
Performance $R. \rightarrow Attitude$	-0,05	0,03	0,12	Rejected
Time R. \rightarrow Attitude	-0,17	0,04	0,00*	Accepted
Privacy R . \rightarrow Attitude	-0,29	0,04	0,00*	Accepted
Financial R. \rightarrow Attitude	-0,04	0,03	0,14	Rejected
Social R. \rightarrow Attitude	-0,18	0,04	0,00*	Accepted
Psycological $R. \rightarrow Attitude$	-0,20	0,04	0,00*	Accepted
Security $R. \rightarrow Attitude$	-0,31	0,04	0,00*	Accepted
Sustainability $R. \rightarrow Attitude$	-0,15	0,05	0,00*	Accepted
Attitude \rightarrow Behavioral I.	0,25	0,04	0,00*	Accepted

Table 3: Path Analysis

* p<.05

As a result of the path analysis, all effects were confirmed except the effect of performance risk on attitude and the effect of financial risk on attitude. Time risk had a significant effect on users' attitude (β : 0.17, p<.05). Therefore, individuals perceive risk in terms of the time they can learn while producing content with artificial intelligence and this affects their attitudes.



Privacy (β : 0.29, p<.05) and security risk (β : 0.31, p<.05) were stated as the two risks with the highest effect on attitude. Therefore, it is clearly seen that these concerns of the participants about artificial intelligence should be addressed. In addition to these, psychological risk (β : 0.20, p<.05) and sustainability risk (β : 0.15, p<.05) also showed a significant effect on the attitudes of the participants. Users do not feel psychologically comfortable when they use artificial intelligence and this affects their attitudes. Similarly, it has been revealed that artificial intelligence applications carry a sustainability risk for the participants and affect their attitudes. In addition to these, their attitudes also positively affect their behavioural intentions. Therefore, various risks affecting the attitudes of the participants should be taken against them.

5- CONCLUSION

The risks of artificial intelligence are addressed by many authors, manufacturers, and governments. In this direction, studies on the risks of artificial intelligence (Featherman et al., 2021; Hwang et al., 2024; Li, 2024) are also increasing. However, there is no detailed information about the risks perceived by users regarding artificial intelligence. Therefore, the study investigated the effects of the risks perceived by consumers on their attitudes and behavioral intentions while producing content with artificial intelligence. In this direction, the effects of performance, time, privacy, financial, social, psychological, security, and sustainability risks on users' attitudes and the effects of their attitudes on their behavioral intentions were revealed. Thus, the risks addressed within the scope of perceived risk theory were expanded and the effects of social, security, and sustainability risks on the use of artificial intelligence were also revealed. While producing content with artificial intelligence, participants perceive time, privacy, social, psychological, security, and sustainability risks, and these have a negative effect on their attitudes. In the studies conducted in the literature, ecommerce, payment systems, chatbots, etc. Perceived risks on such issues affect consumers' decisions (George, & George, 2023; Rohden & Zeferino, 2023; Al Murshidi et al., 2024). Therefore, the study supports the studies in the literature in this direction. However, studies on sustainability risk are quite limited in the literature. Therefore, feeling the sustainability risk is an important output when producing content with artificial intelligence. Users perceive a risk in this direction because they think that artificial intelligence harms energy resources. For this reason, artificial intelligence companies need to produce energy-efficient artificial intelligence systems and share their studies in this direction with users. The factors that affect the participants' attitudes the most are privacy and security risks. This finding obtained in the study supports many studies in the literature (Featherman et al., 2021; Pillai et al., 2022; Hwang et al., 2024). Therefore, artificial intelligence companies should be restricted in that users' data will not be used by 3rd party partners and for other purposes. For this, it is essential for states to increase their measures/rules/laws against artificial intelligence companies. Other elements that users perceive as risk are social and psychological elements. The negative opinions of people around them seriously affect users (Crespo et al., 2009). In addition, it can be stated that users are not psychologically comfortable while using artificial intelligence. Therefore, assurance should be given that the use of artificial intelligence will not lead people to bad events. The very rapid development of artificial intelligence technologies and the idea that people's jobs will be affected may also affect individuals' safe use of artificial intelligence in this regard (Wang & Wang, 2022). Finally, time risk also negatively affects participants' attitudes. Here, the time that participants will spend on learning artificial intelligence technology comes to the fore.



Since consumers think that the process of learning to produce content with artificial intelligence may take a long time, they perceive risk and can affect their attitudes and behavioral intentions (Bhaskar et al., 2024). In the study, no effect of performance risk and financial risk on consumers' attitudes was found. This is thought to be due to the fact that artificial intelligence technologies have recently developed and are much more intelligent than the average human brain. As the number of illogical/unreliable answers decreases, the performance risk perceived by consumers decreases (Koay et al., 2023). Therefore, no effect has been observed on their attitudes. Financially, consumers do not perceive a risk in this direction because they think that they will not have any problems in getting what they pay for artificial intelligence. This can again be explained by the fact that artificial intelligence develops very quickly and users are willing to pay for this information (Namahoot & Jantasri, 2023). As a result, it is thought that as artificial intelligence develops and better versions emerge, the sustainability, social, psychological, privacy and security risks perceived by consumers may also increase. Therefore, artificial intelligence companies and policy makers need to take precautions quickly.

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INFLATION, INTEREST-RATE POLICIES AND GLOBAL ECONOMIC UNCERTAINTIES IN G7 COUNTRIES

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ABSTRACT

This study aims to examine the interest rate policies and inflation dynamics of the central banks of the G7 countries and to evaluate their global economic expectations. The increases in interest rate policies and inflation rates in the G7 countries have caused instability in the worldwide economy. When energy price increases are considered the leading causes of inflation, they also directly affect the general course of inflation with deviations in the labour markets. The economic uncertainties in the G7 countries in the recent period have further increased inflation rates and made tight monetary policies inevitable. The G7 countries prioritize a process that increases interest rates even more to control the money supply and prevent inflation. The US Federal Reserve (FED) has frequently brought tight monetary policy practices to the agenda by increasing the policy rate by 4.5% in 2020-2022. In addition, although the European Central Bank (ECB) has implemented interest rate increases in a controlled manner, it has preferred to follow a gradual-level policy path that considers the economic formations in Europe. It is observed that the inflation rate changes in G7 countries increased further in 2021 due to the COVID-19 pandemic and its aftermath, leading to severe economic recessions. It is observed that the increasing demand and significant increases in energy prices after 2022 constitute the critical reason for the growing inflation after 2022. Deviations in supply-demand imbalances, increases in energy costs, and employment deviations in labour markets have turned into phenomena with significant economic consequences in G7 countries. In contrast, while unemployment rates have decreased in the US and the UK, increasing unemployment rates in other G7 countries have brought both inflationary pressures and a process in which economic uncertainties have increased.

Keywords: Economic Uncertainties, Financial Fragilities, G7 Countries, Interest Policies, United States Federal Reserve (FED).

JEL Codes: F33, F38, F42.

1. INTRODUCTION

Regarding the study of G7 countries, we should emphasize why they constitute approximately 45% of the world economic output at the global level in terms of Gross Domestic Product (GDP) and that they are the determining factors in monetary policies and international trade. This pyridoxal regressive location can cause inflation on a large scale, especially in economies and global markets, and can provide essential positions for increasing inflation worldwide. At the same time, it also reveals that monetary policies have become a position that directly affects inflation worldwide, with effects such as energy crises and some delayed effects in implementing risks arising from geopolitical positions. Especially in G7 countries, in addition to the decrease in purchasing power, some practices that the central banks of G7 countries have emerged with tightening monetary policies, significantly increasing credit costs and increasing interest rates, are observed to be in a location that can further increase the risk of recession (IMF, 2010).



Efforts to control inflation, especially with interest rate hikes, by creating a negative and oppressive effect on economic growth and recession It is observed that the structure that also increases the risk of recession has found a place in the recent process with a structure that increases the risk of recession. However, of course, the continuous and more frequent fluctuations in the global financial relations at the international financial level are seen as important reasons for global financial instabilities, and it also reveals another issue that needs to be implemented, especially in the approaches to fiscal policies. In this context, the sanctions that encourage the diversification and localization of production and its regional handling, especially in understanding the global supply chain, need new production facilities with strategic sectoral dependencies. It is observed that the tightening policies of the central banks in G7 countries and the processes that the governments address in the fiscal policies, especially in the long term, to ensure price stability, pose significant difficulties in completely controlling global uncertainties and inflation in the short term. Therefore, it is observed that the decisions taken by G7 continuously in the fight against inflation have negatively impacted developing countries and the financial markets and created a negative global impact value, hurting all international trade (André et al., 2022).

It should be emphasized that the most crucial reason for the emergence of global uncertainties, especially for the G7 countries, is global geopolitical risks and deviations in global trade options. It appears that the increasing energy demand and energy supply security, especially during and after the war, have also had a vital uncertainty effect on this issue. In terms of financial markets, it is understood that the protectionist policies in the global trade chain, especially in recent years, have increased, especially at the public level, and the increase in global debt levels has emerged as a significant cause of uncertainty and a phenomenon that further increases the financial risks (Antonakakis, 2012). One of the most critical issues ignored here is that it has become a substantial cause of uncertainty, especially regarding natural gas and oil and their prices, in positions related to climate change. It should be emphasized that the difficulties in reaching specific standards in agreements aimed at controlling sustainable development policies, especially those on carbon emissions, are an essential cause of uncertainty. On the other hand, the continuous changes in foreign exchange markets, especially in terms of unemployment, income distribution, and financial stability, and especially the constant variability of currency that can be expressed as reserve currencies such as the US dollar and the Euro, have reduced global investor confidence (Bjørnland & Leitemo, 2009).

2. RECENT PERIOD GLOBAL UNCERTAINTY FACTORS AND STRUCTURAL DYNAMICS REGARDING G7 COUNTRIES

For G7 countries, global uncertainty elements emerge with structural impact values based on different uncertainty values, especially in terms of inflation and interest rate variability in economic terms. Even though these structural impact values have created different trends among countries with different values emphasized, it should not be overlooked that inflation and interest rate impact values have a determining feature. Especially for G7 countries, which are considered developed countries, these macroeconomic uncertainty elements can be listed in a few primary items, apart from some trends that can be expressed differently. Among these items, it is observed that the technological and technical approaches in the recent period, especially the Covid-19 pandemic, have had significant effects and have turned into uncertainty elements in terms of protecting some of the workforce or short-term self-employed people.



It is observed that all of these have been expressed within the effect framework of the subject that can be evaluated within the technological transformation studies. It is possible to emphasize these macroeconomic uncertainty levels at the global level for the G7 countries within the scope of structural change dynamics by considering them within the scope of several main items as follows:

• As a structure that can be assessed within the technological transformation studies, it has recently made itself felt heavily. This heavily felt branch, especially the "*Industry 4.0 Technological Development*" and change effects, has found a place in the process. A significant trend has also shown itself. This technological transformation trend has demonstrated its adaptability capacity, especially for future powers for G7 countries. It is observed that "*Industry 4.0 And Technological Transformation Rotation*", especially outside of the capacity to adapt, will lead to radical industrial changes in new countries and that it has turned into a social policy that will affect their growth and has aimed to provide efficiency policies and economic growth automation with a specific increase. It is observed that it has become an essential location with some uncertainties, and it is difficult to determine the final effects at the global level with a structure that will be represented as a priority and pioneer in the process (Simovate, 2024).

On the other hand, undoubtedly the most crucial uncertainty element is the coronavirus-19 pandemic process, which has been experienced recently for the G7 countries and has had significant macroeconomic and financial effects on the global level after 2019. In this process, there has been a structural activity differentiation and deviations that have been particularly affected by the G7 countries, and it is understood that it has taken place as an essential process that has created significant deep-rooted effects on the G7 economies. It is seen that the process, especially where economic support and packages are concerned and the development of social economic support policies for the self-employed has emerged with a significant impact value, also has emerged with a considerable impact level regarding the effectiveness of policies and the sustainability of the countries' extraordinary economic development and their activities and the durability of their financial resources. It is observed that this Structure, which emerged rapidly in the recovery room after the recovery the Corona-19 process, has also directly affected the processes in terms of the recovery process and that the support packages have become a significant global uncertainty trend among the countries in the worldwide process within a significant imbalance process and has also become concrete as a factorial distribution. Analyses that see the significant reason for the increase in inflation and interest rates at the global level, especially for the G7 countries, as the COVID-19 process emphasize that these economic factors are associated with the COVID-19 process, especially with some configurations related to the system (Congressional Research Service, 2021).

• The global energy policies have undergone significant changes in line with economic and geopolitical factors. Energy sustainability has become a critical global uncertainty for the G7 countries due to markets caused by the Russo-Ukrainian War have brought the issue of energy supply security to the forefront and caused the G7 countries to reshape their energy policies, thus creating uncertainties. Because the Russo-Ukrainian War has had profound effects on energy markets and increased criticism of energy dependency in many G7 countries, especially in Europe. The fundamental uncertainties facing the G7 countries in the context of energy sustainability can be expressed as the transition to renewable energy, decarbonization policies, energy supply security and global uncertainties in approaches to reducing fossil fuel dependency.



The main reason for this phenomenon is that fluctuations in energy supply have become significant uncertainty factors in the long-term energy policies of the G7 countries and have negatively affected the scale of global energy distribution. European countries aim to switch from fossil fuels to more renewable energy sources in this process, countries such as the United States and Canada have accelerated their investments in shale gas and hydrogen energy and directed their global impact values to different focuses. G7 countries must accelerate the transition to renewable energy to achieve the targets set within the framework of the Paris Climate Agreement goaling of becoming carbon neutral by 2050 necessitates reducing dependence on fossil fuels and turning to alternative energy sources. Increasing the share of renewable energy sources and reducing carbon emissions have been significant uncertainties in the policies put forward during this process. These trends are seen as significant reasons for a global uncertainty process in which significant changes are experienced in global energy markets and G7 countries are following different strategies. The high costs and infrastructure investments in the transition to renewable energy create a financial burden for G7 countries, while the difficulties (Demirer et al., 2021).

In recent years, changes in global economic dynamics have led to inflation rates becoming a major problem in G7 countries. The deepening of global effects and uncertainties make it difficult to achieve economic growth and macroeconomic stability and demographic changes in emerging markets, emerge as a major challenge at the global level when considered from an economic growth. In this context, the aging workforce population in countries such as Germany, Japan, and Italy, the widespread use of remote working models, and the potential of digital technologies to increase labour productivity are causing increased uncertainties in economic growth models. Developing technology and artificial intelligencesupported automation processes are of great importance in terms of their effects on productivity. The development of artificial intelligence-based business processes and the increase in labour productivity have become a strategic focus in making economic growth sustainable, especially for countries such as the United States and Japan. However, the effects of this transformation on capital investments and global competitiveness create new uncertainties in the economic policies of G7 countries. China's increasing productivity and green economy-focused investments are causing structural changes in capital movements and reshaping economic risks on a global scale. However, when energy sustainability, export dynamics and the effects on economic growth are considered within the framework of inflation and interest rates, it becomes inevitable that structural uncertainty elements will increase (Levine et al., 2016). The differentiation of capital efficiency and investment strategies among G7 countries highlights global economic imbalances. This process causes global economic conflicts and deviations to emerge at different levels among G7 countries and necessitates re-evaluating economic policies. As a result, transformations in the global economic system have become one of the most critical factors affecting the economic growth strategies of G7 countries. Global capital flows, technological transformations, and demographic changes are the primary sources of economic uncertainty (Fink & Schüler, 2015).

G7 countries need to develop new techniques and restructure their economic policies to adapt to global uncertainties and maintain their competitiveness at the global level. It should also be emphasized that the increasing interest rates, especially at the global level, and the fact that investments in energy investments related to capital structuring are costlier, together with the rising energy factors, have an essential effect on increasing interest rates.



The factors create in terms of the sustainability of global energy policies have been significant uncertainties process. Increasing public and private sector cooperation in the energy transformation process, encouraging investments in energy technologies and creating long-term energy plans require a meaningful and effective process to overcome these uncertainties. However, they have created a significant contradiction with global policies such as green economy policies and have become an element of uncertainty between the G7 countries and the other countries. In particular, the fact that some G7 countries have not accepted global agreements on "Green Economy" policies or have not wanted to be a part of these agreements has brought the level of international influence of the G7 countries and the applicability of effective conciliatory policies to an uncertain position as an element of uncertainty that has been evaluated.

3. GLOBAL ECONOMIC TRENDS, UNCERTAINTIES IN INFLATION AND INTEREST RATE PROCESS FOR G7 COUNTRIES

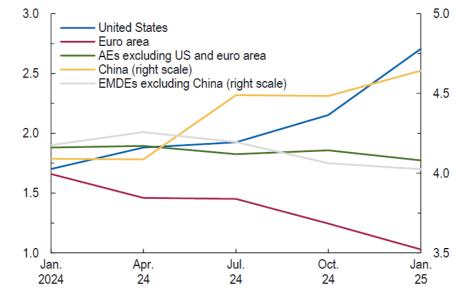
Changes in inflation and interest rates are of great importance in analysing macroeconomic uncertainties, which G7 countries and the emergence of such uncertainties and their comparative consideration with economic growth trends provide a critical perspective for understanding economic dynamics. Changes in inflation rates within economic growth trends and the effects of policy practices regarding interest rates on the proportional change process stand out as one of the determining factors. In terms of economic growth, the macroeconomic dynamics of the United States and the Eurozone, mainly, and the trends revealed by emerging economies such as China provide essential indicators for interpreting inflation and interest rates. When explicitly considered in the case of G7 countries, the interdependent changes in inflation and interdependent interest rates emerge as a subject that needs to be analysed with varying levels of impact according to the countries' economic structures. However, it is seen that changes in inflation rates are an essential variable that determines the lower and upper limits of energy prices in the context of global economic conditions. Especially in interpreting macroeconomic balances worldwide, the trends revealed by the dynamics between inflation and interest rates provide an essential reference point for understanding economic uncertainties. Therefore, it can be said that these changes observed in the G7 countries are critical variables that should be taken into consideration by monetary policy makers both at national and global scales (Schüler et al., 2017).

3.1. Global Economic Growth Trends Concerning the G7 Countries' and Regional Macroeconomics

In direct relation to the macroeconomic variables of the G7 countries, the economic growth trends at regional and global levels reveal an essential trend. In this context, the economic growth trends in question effectively determine the estimated values of the countries regarding regional changes, which is in a critical position when compared to the G7 countries. Especially in evaluating the position of emerging economies within the regional structure, the inclusion of countries such as China, the European Union, the United States and the Eurozone in global economic growth trends enables the international economic dynamics to be addressed within a meaningful framework. The macroeconomic comparison, including the Eurozone and G7 countries, including the USA, provides a crucial macroeconomic infrastructure for analysing global growth trends, inflation and interest rate variations.



Accordingly, when countries' economic growth rates are high, as China, among the emerging economies, is considered, these countries' increasing influence within the global economy becomes evident, especially when compared to the USA and the Eurozone (Galati et al., 2016). M. This comparison allows interest rate and inflation variability to be evaluated within the framework of uncertainties. It provides an essential analytical basis for a more precise and explicit understanding of our topic's macroeconomic targets, such as inflation and interest rate variability. Graph 1 below shows the rates related to economic growth estimates covering the first months of 2025 and enables monitoring these growth trends in percentage slices. The graph provides an essential perspective on the regional reflections of global economic developments and allows the analysis of macroeconomic variability between G7 countries and other economic regions:



Source: IMF (2025). World Economic Outlook Update: Global Growth: Divergent and Uncertain, IMF January 2025, Washington, D.C.: International Monetary Fund (IMF), p. 3.

Graphic 1. Evolution of 2025 Economic Growth and Forecasts (%)

Graph 1, presented above, is of great importance in understanding the significant economic growth fluctuations observed in these countries and the extent to which they are affected by inflation and interest rates, which are considered macroeconomic variables. Its structure includes various regional comparisons of the G7 countries. In other words, the graph evaluates the economic dynamics of the G7 countries at different scales. It reveals, especially in the United States and the Eurozone, how they are shaped in terms of economic indicators. The left axis in the graph represents values ranging from "1.0" to "3.0" of range, which is a standard scale used to evaluate the general growth performance of developed economies.

When examined in terms of the G7 countries, this scale, which provides a meaningful evaluation in the context of macroeconomic variables, allows for analysing the relationships between economic growth and other fundamental indicators. On the other hand, when the right axis is examined, it is seen that comparing China's economic growth dynamics with those of the G7 countries in the globalisation process is of critical importance.



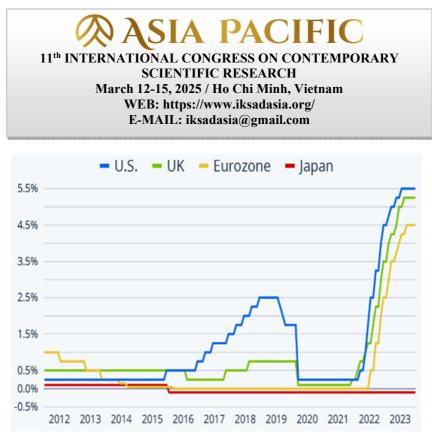
In this context, it is striking that a different scaling approach has been adopted for other developing economies, excluding China. The January 2024 period is examined to analyse regional economic growth variability, and it is observed that an economic growth trend of approximately 1.6% has emerged in the Eurozone. However, this growth rate does not generally constitute a significant upward trend for the G7 countries.

On the contrary, it reflects a relatively stable growth trend (Canova & Schlaepfer, 2015). The data obtained shows that it is directly related to high inflation and interest rates, which is the economic growth performance of the G7 countries remained low. What should be emphasised in particular is the comparative economic performance of the United States and the Eurozone. This fact reveals that the US economy has strong growth trends while the Eurozone is experiencing economic stagnation due to high inflation and interest rates. While the United States continues to be one of the main actors driving the global economy with its solid financial foundations and growth capacity, the Eurozone is struggling economically. Global economic growth dynamics are considered, and the USA, as a G7 country, stands out as one of the two main actors determining global growth trends.

3.2. Main Policy Interest Rates and Global Uncertainties in G7 Countries and Selected Regions

It is possible to talk about a policy interest rate balance where some of the most critical interest policies in the G7 countries have a common consensus among the new G7 countries and are at close rates. Apart from this consensus, it is also necessary to emphasize that a meaningful decision was made by the Federal Reserve Bank, the Central Bank of the United States, at its last policy meeting with the decision to keep it constant. In the G7 countries, a fixed interest rate is taken for stability and economic growth, especially regarding the decision to be taken below inflation, which reveals that it is still close to these rates around "5.1". It is also necessary to emphasize that the policy interest rate remains at "0.1%" in Japan. This application, especially in Japan, which is also included in a type of application as a negative interest rate policy, also reveals the critical purposes of low-interest rate policies that can be implemented to combat deflation and encourage economic growth.

However, in any case, it is noteworthy that the European Central Bank (ECB), which follows the Eurozone, especially in Germany and France, and which also includes Italy, still has policy interest rates at "4.25%" and "5.1%", and that there is a common consensus in determining interest rates by taking global economic developments into account. However, a decisive common interest rate policy in interest rate policies is a current analysis and discussion topic that may change with the effect of global inflation. Different values may also be revealed in the interest rate policy for each of the G7 countries. In this sense, the aim is to continue a balanced economic structure and prevent uncertainties even if the target inflation levels cannot be approached in determining interest rates, especially in the United States, after COVID-19 is that interest rates are aimed at increasing investments by keeping them at a lower level by exceeding the stable market values. In Chart 2 below, it is possible to monitor the change in the main policy interest rates by central banks in selected G7 countries/regions from 2012 to the present day:



Source: Martin Armstrong (2023). Economy: Central Banks Extend Interest Rate Plateau. Statista, December, 15, 2023, https://www.statista.com/chart/21070/main-policy-interestrates-in-selected-countries-and-regions/ (Accessed March, 02.2025).

Graphic 2. Main Policy Interest Rates by Central Banks in Selected G7 Countries/Regions

As can be seen from the above Graph 2, there are significant increases in interest and political interest rates, especially in the post-COVID-19 period and in the G7 countries and the Eurovision region, where the G7 countries are included. This threshold increase effect is breaking the interest rate threshold financially. The first stage started after 2015 and in 2016 and then reached a level of 2.5% in 2018 and 2019. After the COVID-19 pandemic process, the political interest rate reached 5.5% in all G7 countries and the Eurozone region and especially in the United States, and this rate is observed to have turned into a significant negative interest rate process in Japan, with Japan also lowering interest rates and having an adverse effect on an inflation trend.

Despite all this, the fact that these increases, especially in the United Kingdom and the United States, are even higher in the Eurozone has turned into a period of uncertainty, meaning that rising interest rates are pushing global inflation to even higher levels, with the effect of increases in monetary liquidity, and triggering inflation (European Parliament, 2023). Especially at the global level, the fact that interest rates were low in the United States between 2020 and 2022 has also been the subject of discussions on creating uncertainty as a significant deviation phenomenon reflected in Continental Europe and creates discussions among other G7 countries. These discussions have also been the subject of conversations on the understanding of these ongoing values and the fact that the global variability in interest rates has acted in the same trend after 2022, even though this decline in the United States between 2020 and 2022 has also turned into a position that affects emerging market economies with significant financial vulnerabilities, especially at the global level, in terms of interest rate deviations.



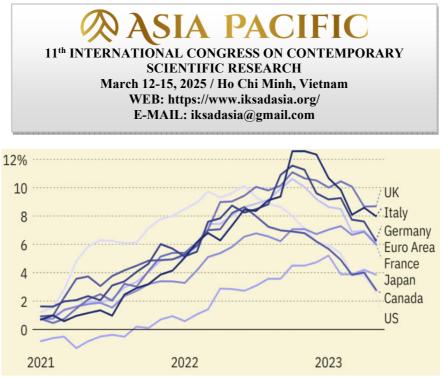
Although this uncertainty emerges as different values especially for developing countries in such cases, the fact that the strategic monetary and financial approach of the United States is an essential to presential discussion in interpretations, and that interest rate policies should be reviewed and included in the process by the Federal Reserve (FED) in other emerging market economies, means that developing economies inevitably arise when a negative financial break occurs as interest rate variability. The different interpretations of these financial vulnerabilities, especially in emerging market economies, and the emergence of an increasing trend in the United States with the highest interest rates at the global level after 2022, are evaluated as an effort of all G7 countries to overcome financial uncertainties towards achieving a global balance (Yaya et al., 2021)

3.3. Recent Period Inflation Rates in G7 Countries in the World and Probably Uncertainties

It is understood that the variable and increasing rates of inflation, especially in G7 countries, have created quite serious Macro uncertainties in recent years and that it is inevitable to include different impact values in the process based on decisions that can be taken at the global level regarding G7 countries. This process also means a Phenomenon in which the expectations and the importance of financial global impact values in affecting the existence of the global economy based on G7 countries are subject to deviations, and these values are directly affected by inflation, and investments are also negatively affected (CBRT, 1999).

This financial phenomenon has also frequently brought to the agenda the possibility of a structure where the uncertainties directly related to inflation and the medium- and long-term inflation uncertainties can be subject to significant deviations in expenditure accounts in G7 countries. It is very clear that the structure in which inflation rates increase significantly at very high rates is after the COVID-19 pandemic process after two or 2019. It reveals that especially in countries where inflation rates are almost 1% and 1.5% and especially in countries such as Italy and the United Kingdom, the increases have resulted in a very high proportional inflation increase of up to 12%-13%, especially in the post-COVID-19 period.

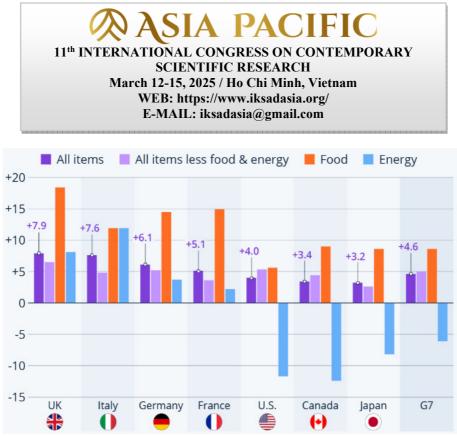
It also frequently brings to the agenda the inevitability of significant global financial deviations in values that can be expressed differently and the relationship between interest rates and a situation where increasing inflation rates have affected the recent fiscal and monetary liquidity policies of the G7 countries. It is also observed that even if this relationship has entered a downward trend within the G7 countries in 2023 and beyond, it is not the case that a structure before the COVID-19 process has returned to the balance elements and that uncertainties may continue today, affecting medium and long-term global and financial plans and bringing to the agenda a significant chain of contradictory possibilities with uncertainties (Yousefi et al., 2023). It also reveals that it does not add to the agenda based on global investments and capital transfers. In Chart 3 below, it is possible to monitor the variability values of the inflation rate increases in G7 countries, especially after the COVID-19 pandemic, until 2024:



Source: Jordan Weissmann (2023). *The Two Charts President Biden Wants Voters to See*, https://www.semafor.com/article/07/06/2023/the-two-charts-president-biden-wants-voters-tosee (Accessed February, 23.2025).

Graphic 3. Recent Period Inflation Evaluation – Changes in G7 Countries in the World As observed in Chart 3 above, significant inflationary deviations have occurred in the global economy following the COVID-19 pandemic, and when the issue is evaluated in terms of global inflation dynamics and its impact on monetary policies, the rise in inflation and its impact on monetary policies, especially since 2021, has become evident in the post-2021 period. This process has led central banks to increase interest rates and has deepened economic uncertainties. The extent to which inflation rates affect which groups of goods and services plays a critical role in understanding this period of uncertainty. Inflationary pressures, especially observed in basic consumption items such as energy and food, have made imbalances in the global economy even more apparent. In the post-2023 and post-2024 period, the dynamics of inflation rates on a global scale have manifested themselves with unexpected and uncontrollable price increases, especially in G7 countries (OECD, 2023).

This process has led to fluctuations in global financial markets and has also caused serious increases in commodity and food prices. It is observed that inflation in G7 countries peaked at 13% to 14% in early 2023 and caused significant monetary liquidity fluctuations in the global financial system. Although inflation rates have been lowering in some developing countries, especially due to the impact on economic factor prices in global markets, the G7 has had negative effects on the global investment environment and financial uncertainties have increased due to the high inflation experienced. How inflation rates are shaped both at a general level and on a specific commodity group basis continues to be a critical element in ensuring global economic stability (United Nations, 2022). These uncertainties, which continue in the global economy especially as of 2023, necessitate the adoption of more cautious approaches in financial decision-making processes. As can be seen in Chart 4 below, when the distribution of inflation rates and price movements in different commodity groups in the G7 countries throughout 2023 is examined, it is determined that global financial fluctuations continue, and the effectiveness of monetary policies has decreased:



Source: Florian Zandt (2023). *Macroeconomics: Which G7 Economies Have the Highest Inflation?*. Statista, July 13, 2023, https://www.statista.com/chart/30398/inflation-rates-in-g7-countries/. (Accessed February, 17.2025).

Graphic 4. Distribution Inflation Rates Variables for All Items in G7 Countries Throughout 2023 (%)

When Graph 4 is examined, it is understood that although all the items constituting the general inflation rates are expressed in different values, the lower and upper limits differ significantly, especially for food and energy consumption. This situation shows that inflation in G7 countries directly depends on fluctuations as a structural interaction value. The inflation-related changes related to such volatility lead to more significant deviations, especially in food and energy items, than other components. When the elements of inflation are examined, it is seen that the average inflation increase for 2023 is approximately 7.9% when all expenditure items are considered. However, this value reaches higher rates for food and energy items and shows that inflation reaches 13% in some cases.

Such a change reveals a significant fluctuation in general price levels and the average values of basic consumption items such as energy and food (EuroChambres, 2023). When evaluated, especially in the context of the United Kingdom, it is seen that these inflationary changes have pretty significant effects on macroeconomic indicators. Similarly, it is observed that other major European economies, such as Italy, Germany, and France, show a similar trend to previous years in terms of lower and upper inflation values. However, factors such as the differentiation of monetary policies in these countries, the variability of interest rates and floating exchange rate policies significantly affect the degree and composition of inflationary pressures. In this context, it is necessary to emphasize the uncertainties regarding the fiscal policies that inflation has created in the G7 countries recently, especially in the last few years. Based on the above Graph 3, the most critical issue that needs to be emphasized is that it has emerged with the uncertainties on tax revenues in the G7 countries (European Central Bank, 2023).



Even if it is expressed with a structure that can cause individuals and companies to enter higher tax revenues in actual real tax revenues, it should also be emphasized that the deviations in tax revenues in particular have become incompatible with the taxation mechanisms and that tax policies regarding inflation have caused a significant increase in tax burden due to this incompatibility. Uncertainties on tax revenues, especially regarding real changes in indirect taxes, reveal even more meaningful results regarding uncertainties. In particular, indirect taxes such as special consumption tax, value-added tax and purchase consumption taxes have caused price increases at different values depending on the price increases and have also found a place in the process as a vicious circle between inflation and tax uncertainty. This situation, which is entirely meaningful for the G7 countries, has become a concrete problem that has emerged as public expenditures and budget balance uncertainties with significant impact values, especially regarding tax revenues (Serin & Demir, 2023). Some difficulties in planning public expenditures and the inadequacy of public expenditures against inflation in the long term, such as health and education, reveal that it has become a significant uncertainty trend for G7 countries, especially with the increase in budget deficits that can be revealed and the considerable rise in interest expenses.

4. DISCUSSION

In showing all these trends, the increase in public debt dynamics and the costs of debt services, on the other hand, even though the decreases in the value of the debt are demanded as an essential government income and perceived as an inflation tax, it also reveals that it finds a place in the process with a structure that can cause high returns and the government to borrow at a high cost in its new borrowings. This process also means that social expenditures create political uncertainty and that the harmony of interest policies and fiscal policies is difficult to achieve. It is also seen that the increase in interest rates by central banks, especially in G7 countries, in the fight against inflation and the governments' preference for expansionary fiscal policies regarding economic growth provisions have turned the interest and inflation dynamics into a vicious circle with a more complex spiral.

It has revealed a financial discipline problem that can negatively affect both public debt strategies and economic growth policies for G7 countries, which has also become a financial phenomenon related to uncertainty for G7 countries. Inconsistencies in monetary and fiscal policies regarding political responses the policy of strengthening trade agreements in trade and investment policies as an optional policy again reveals an uncertainty with global relations on developing countries as an essential political response, especially the open market strengthening of purchase and sale policies monetary policies based on unity management approaches have also failed in the recent process, we should especially emphasize that it has found a place in the process as a reason for the importance of uncertainty regarding economic uncertainties (Sağdıç et al., 2020).

While financial innovations at the global level cause specific trends to come to the fore, the effects of the G7 countries on the worldwide economy show geographical differences. When evaluated specifically for the European economy, the effects of G7 countries on macroeconomic stability are clearly felt. However, Japan's economic structure within the G7 and its monetary policies reveal that it follows a different strategy than other countries. Japan's low-interest rate policy and different inflation dynamics have led to the emergence of different impact values at the global level, and this has increased the uncertainties of economic policies for the future.



As a result, the global effects of inflation and interest rates in the context of G7 countries have become a critical variable regarding both short-term financial stability and long-term economic growth. A structure in which investor security in private sector investments is damaged, especially with the gains in investments in the private sector, especially on the economies of their countries, both the slowdown in the economic growth rate and especially uncertainty-carrying facts are observed. For G7 countries, the correlation effect of interest rates and inflation rates has become a subject of debate, and it is understood that it is a possible effect on investments.

However, it is understood that this controversial fact is also a critical correlation category for discussions that may arise with different values and that it is inevitable for an essential debate to come to the agenda about whether it will affect the inflation values of each G7 country. This discussion also makes it meaningful that the impact values that can be expressed with different values reveal the structure that different impact values can emerge for each G7 country (OECD, 2024). This significance also makes it inevitable for the impact values of each country to be evaluated singularly and specifically for each country, primarily based on G7 countries, where every value that can be expressed differently can be positioned with its different structure. This fact, which is becoming an essential subject of debate, also emerges as a necessity for each country to have different impact values in expressing a critical issue that can be described with varying impact values. The structural change phenomenon in this phenomenon carries the meaningful structure of the United States Central Bank (FED) to a global uncertainty environment, especially with a structure where the impact values of different interest rate policies on the continental European Cup emerge for different purposes.

5. CONCLUSION

The global economy has undergone significant structural changes in recent years, especially in the direct and indirect effects of inflation and interest rates, which changes' impact on financial markets and macroeconomic policies have increased predictability problems at the global level and deepened the economic uncertainty process. Fluctuations in inflation and interest rates interact with different economic variables and cause a learnable uncertainty environment in international markets. In this context, one of the most important factors underlying these uncertainties is that different economic indicators interact with variables with high impact values. The shaping of interest rates by economic policy tools necessitates a more comprehensive questioning of their effects on inflation. The recent increases in inflation have directly affected changes in interest rates, leading to critical consequences for global economic policies.

In this context, when the dynamics of interest and inflation among the G7 countries are evaluated together with global economic trends and policy responses, it is observed that uncertainties regarding macroeconomic stability have increased. The financial uncertainties that G7 countries, especially on their basis, address at the global level is seen as the most important reasons for continental Europe's inflation phenomenon and the cause. On the other hand, this causal justification has created differences in importance among G7 countries regarding different fluctuations in interest rates, which is an important uncertainty issue. Different interest rate fluctuations of G7 countries, as the most developed countries, necessitate the evaluation of analyses with varying values of impact of the capital structure at the global level and their significant negative results. It is seen that financial investments at the international level have emerged with essential determinations that are considered a substantial source of uncertainty during and after the COVID-19 pandemic.



The fact that these determinations create impact values with different values, contrary to a position that may result in a further decrease in the capital transfer and capital profit margin costs on underdeveloped countries, primarily based on developed countries, also reveals that there is a negative impact return as a return of the cost increases of increased capital investments as a significant uncertainty issue on G7 countries as a global investment effect. The existence of different economic structures and policy preferences among G7 countries increases the uncertainty in the global economy, which in turn increases the variability of inflation estimates. Therefore, the impact values of interest rates and inflation on a global scale should be analysed more carefully in shaping future economic policies.

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IMPACT OF TRADE LIBERALIZATION ON ECONOMIC GROWTH IN NIGERIA

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ABSTRACT

This study examines the impact of trade liberalization on economic growth in Nigeria. The focus is on the effect of trade liberalization on economic growth in Nigeria between the periods of 2004-2023. The dependent variable is economic growth while trade openness, net export, net import, exchange rate and balance of payment are the independent variables. The study employed different estimation techniques such as; Autoregressive Distributed Lag (ARDL) model to check for the long run and short run relationship between the variables, Co integration method to test the relationship between the variables, Augmented Dickey fuller unit root test to check if the variables are stationary or non-stationary, Granger causality test to know if the variables are uni-directional, bi-direction or have no causal relationship. The findings indicated in the ARDL model that trade openness, exchange rate, net export exerted a positive and non-significant impact on economic growth in Nigeria in the long-run and net import, balance of payment have a negative non-significant impact on economic growth in the long-run. However, net import, net export, balance of payment and exchange rate have a positive and non-significant relationship in the short run while trade openness has a negative and non-significant relationship in the short-run. It was therefore concluded that net export and exchange rate are potent ways of influencing economic growth, also trade openness, net import and balance of payment can also be used to determine the economic growth in Nigeria. One of the recommendations is that government should put up policies and programs targeted at increasing locally produced export-oriented goods and services in the country.

Keywords: Trade Liberalization, Autoregressive Distributed Lag, causal relationship, trade openness



THE IMPACT OF SOCIO-ECONOMIC FACTORS ON DIETARY TRANSITION: A COMPARATIVE STUDY OF SOUTH AISA AND G7 COUNTRIES

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ABSTRACT

This study analyses the transition from animal-based to plant-based diets and its effects on public health and environmental sustainability, with a comparative focus on South Asia and G7 countries data spanning from 1999 to 2023. Using advanced econometric techniques, including Fully Modified Ordinary Least Squares (FMOLS) and the Autoregressive Distributed Lag (ARDL) model, examine how income, education, urbanization, animal product pricing, and globalization affect food preferences across areas. The findings show major regional variances. Rising income in South Asia encourages animal-based consumption since it is more affordable, but increased income in G7 countries supports plant-based diets due to health consciousness and environmental concerns. Urbanization also has distinct effects on dietary preferences; in South Asia, it promotes diversified food options while increasing processed food consumption, whereas in G7 countries, it frequently leads to a loss in traditional plant-based diets. Higher animal product prices in South Asia tend to encourage plant-based eating, although their impact on G7 countries is less substantial. Globalization has brought about transnational dietary patterns, increasing plant-based intake in G7 countries while pushing Western-style diets in South Asia. These dietary shifts have important consequences for public health since they can help minimize diet-related diseases, as well as for environmental sustainability because they reduce greenhouse gas emissions and put less strain on natural resources. Based on these findings, authorities should create targeted health education programs, increase availability to plant-based foods through subsidies and incentives, and incorporate sustainability awareness into public policies to encourage healthier and more ecologically friendly eating habits.

Keywords: Dietary transition, socio-economic factors, plant-based diet, animal-based diet, income, urbanization, globalization, environmental awareness, health education, food sustainability, South Asia, G7 countries, FMOLS, ARDL, public health, environmental sustainability.

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MACROECONOMIC DETERMINANTS OF INDIA'S EXPORT PERFORMANCE IN A GLOBALIZED ECONOMY (1994 - 2024)

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Abstract

India's export performance has received significant academic attention, especially in the postliberalization era. This study conducts a systematic literature review (SLR) of the macroeconomic factors influencing India's export performance from 1994 to 2024. We analyzed 79 empirical studies using the PRISMA framework to identify key factors influencing export performance. The findings categorize macroeconomic determinants of India's export performance into two aggregated levels: international and national export determinants. Key international-level drivers include foreign direct investment (FDI) inflow and outflow, common official language, geographical proximity (contiguity), free trade zones, and trade agreements. On the national level, important drivers encompass GDP growth rate, technology imports, interest rates, exchange rates, liberalization, trade policies, trade openness, and the intensity of raw material imports. The review highlights inconsistencies in existing research due to methodological variations and fragmented theoretical frameworks. Furthermore, it underscores the need for a comprehensive approach integrating diverse economic theories and advanced econometric techniques. The study identifies gaps in the literature, particularly the underrepresentation of service sector exports, and suggests avenues for future research. By synthesizing three decades of research, this study provides valuable insights for policymakers, business leaders, and researchers in international trade. Keywords: Literature review, India, export growth, determinants of export performance



TECH SUPREMACY AND ECONOMIC WARFARE: THE U.S.-CHINA TRADE BATTLE IN THE 21ST CENTURY

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Abstract

The 21st century has witnessed an intense technological rivalry between the United States and China, fundamentally shaping global economic policies and trade dynamics. This research explores the evolving landscape of U.S.-China competition for technological supremacy and its far-reaching effects on international trade, innovation ecosystems, and geopolitical stability. This study employing a mixed-methods approach, integrates qualitative analysis of policy documents, diplomatic communications and expert interviews with quantitative assessments of trade flows, investment patterns, and technological advancements. This research reveal that the U.S. and China have adopted contrasting strategies while the U.S. emphasizes regulatory controls, alliances, and intellectual property protections, China focuses on state-led innovation, market expansion, and strategic investments in emerging technologies. The escalating trade tensions, including tariffs, export restrictions, and regulatory crackdowns, have led to significant disruptions in global supply chains, compelling businesses to diversify production hubs. Moreover, the decoupling trend has fostered parallel technological ecosystems, particularly in semiconductor manufacturing, artificial intelligence, and 5G infrastructure, reshaping the global innovation landscape. From a geopolitical perspective, this competition has intensified strategic alliances and economic blocs, influencing regional stability in Asia, Europe, and beyond. Countries and multinational corporations are increasingly forced to navigate the complexities of economic alignments and technological dependencies. The study underscores that while competition fosters innovation, prolonged tensions pose risks to economic cooperation, technological standardization, and global security. By offering both empirical insights and theoretical perspectives, this research contributes to a deeper understanding of the U.S.-China technological rivalry and its implications for global economic governance. This research suggests that policy frameworks promoting technological collaboration, fair competition, and supply chain resilience could mitigate the adverse effects of the ongoing power struggle.



DEMOCRACY AT A CROSSROAD: THE ROLE OF MILITARY COUPS IN REDEFINING GOVERNANCE AND CIVILIAN SUPPORT IN WEST AFRICA

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ABSTRACT

Democracy in Africa since 2020, has witnessed not less than ten military coups, each characterised by its unique dynamics and far-reaching consequences on governance, international and civilian supports. West African region experienced most of these coups in Niger, Burkina Faso, Sudan, Chad, and recently Mali. This study delved into military coups that has occurred in the West African countries, its potential consequences on democratic development of the regions, responses of the regional and international actors such as ECOWAS, AU and UN, as well as how it has shaped governance and civilian support for government in those West African countries. This study adopted survey research design through qualitative method of data collection and analysis. The process of collecting data involved CRAAP test, to evaluate the credibility, reliability, accuracy, authenticity, and purpose of those data to be collected for the study. The study has been able to establish the presence of military coup in five countries of West Africa, with no time in sight for the return of democratic governance in those countries. The military has been able to challenge the democratic and constitutional order with question on legitimacy, civilian support, fragile transition, international support, among others. The study identified ethnic antagonism, poor governance and lack of accountability, overstaying in power by democratic leaders, poverty and poor economic performance, corruption and mismanagement and world system dependency theory as some factors that contributed to the rising military coups in West Africa. The study concluded that democracy is faced with challenges of civilian support for military coups and redefinition of governance by those military regimes.

Keywords: Democracy, Governance, Military Coup, Dependency Theory, Government

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IMPACT OF US IMMIGRATION REFORMS ON INDIAN PROFESSIONALS

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Abstract

This paper examines the impact of recent U.S. immigration reforms on Indian professionals, particularly those in high-skilled sectors such as technology, healthcare, and engineering. Indian migrants have long been a vital part of the U.S. labor force, contributing significantly to its economic growth and innovation. However, recent policy shifts, including changes to the H-1B visa program, Green Card processing delays, and the tightening of immigration laws, have introduced new challenges for these professionals. The paper explores how these reforms have affected Indian professionals' career choices, job stability, and long-term settlement plans. While some reforms, such as the expansion of global talent programs, have offered new opportunities, others have resulted in increased uncertainty regarding visa statuses and pathways to permanent residency. These changes have led to heightened competition for limited work permits, longer processing times, and a sense of instability among Indian workers who are critical to key U.S. industries. The paper also discussed the socio-economic effects on Indian professionals and their families, including challenges related to family reunification and social integration. Through an analysis of relevant policy changes and interviews with Indian professionals, this paper sheds light on the broader implications of U.S. immigration reforms on the professional lives of Indian migrants. It highlights the need for more adaptable immigration policies that can support the evolving role of skilled workers in the U.S. economy while fostering bilateral ties between the U.S. and India.

Keywords: U.S. Immigration Reforms, Indian Professionals, H-1B Visa Program, Green Card Processing, High-Skilled Migration, Skilled Labor Market, Immigration Policy



ALBANIAN DIPLOMACY IN THE 1920S AND 1930S AND DIPLOMACY TODAY: A COMPARATIVE ANALYSIS

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Abstract

This article provides a comparative analysis of Albanian diplomacy in the 1920s and 1930s and its evolution in the present day, focusing on the key challenges, strategic approaches, and the influence of international dynamics. By utilizing archival documents from the Albanian State Archives and foreign diplomatic records, as well as official government reports and scholarly sources, this study examines the role of diplomacy in shaping Albania's international standing. During the interwar period, Albanian diplomacy was primarily concerned with securing international recognition, maintaining territorial integrity, and navigating the influence of major European powers. In contrast, contemporary Albanian diplomacy is characterized by its commitment to European integration, active participation in NATO and international organizations, and efforts to strengthen regional cooperation. The analysis highlights both the continuities and transformations in Albania's foreign policy, emphasizing the shifting priorities and institutional developments over time. The study also explores the challenges faced by Albanian diplomacy, from external pressures in the early 20th century to the complexities of modern global diplomacy. By comparing these two periods, the article provides insights into the long-term trajectory of Albania's foreign policy and its evolving role in the international arena

Keywords: Albanian diplomacy, foreign policy, modern diplomacy, international relations, European integration.

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APPLICATION OF GEOMATICS TO LANDSLIDE PREDICTION : THE CASE OF THE OUED LAOU REGION (RIF, MOROCCO)

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Abstract

Landslides are destructive phenomena caused by human activity (infrastructure construction) or by natural phenomena, whether climatic, geological or geomorphological. Landslides sometimes have major human and economic consequences, which is why it is so important to predict and prevent these phenomena, especially in mountainous regions. So, in order to protect against the risk of landslides, it is crucial to define and characterise the areas susceptible to these phenomena. In this context, the Rif mountain range in Morocco, whose structure corresponds to a stack of nappes characterised by divergent discharges towards the outside of the Rif, records landslides from time to time. The Oued Laou region, the subject of this study and part of the Rif mountain range, is prone to landslide instability. As a result, and in order to prevent and minimise the impact of landslides in this region, it is imperative to list the areas where it would be necessary to intervene in order to anticipate potential dangers. To achieve these objectives, this study is based on a multi-criteria analysis of the causal factors, whether they be permanent, slow-moving predisposing factors (lithology, vegetation cover, slope, hydrographic network, fracture density and slope exposure), which affect the extent of the phenomena, or fast-moving triggering factors (earthquake, heavy rainfall event, human action, etc.), which affect the occurrence of the phenomena. Maps of the various factors likely to contribute to ground instability are drawn up on the basis of existing cartographic documents, field data and satellite imagery. By integrating and combining these maps in a GIS environment, it has been possible to accurately identify and map areas at risk of ground movement. The resulting map provides a very useful document for predicting, planning and directing the actions of local authorities to anticipate the course and consequences of this phenomenon.

Keywods: Géomatique, SIG, Prédiction, Glissement de terrain, Oued Laou.



IN-SITU EFFICIENCY ESTIMATION OF INDUCTION MOTORS USING PARAMETER IDENTIFICATION

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1. ABSTRACT

Since three-phase asynchronous motors have a wide range of applications, it is important to accurately define their parameters for the application of adjustable speed control systems. Therefore, suitable optimization algorithms should be chosen for precise estimation of asynchronous motor parameters. This paper applies Harris Hawks Optimization (HHO) and Particle Swarm Optimization (PSO) algorithms, which are widely utilized in engineering, to estimate the parameters of a 2.2 kW three-phase asynchronous motor. Efficiency estimation is performed non-intrusively by determining the motor's equivalent circuit parameters. The objective function is defined by calculating measured values such as motor current, input power, power factor, and rated output power. The convergence speed and parameter estimation performances of the HHO and PSO algorithms are compared. Experimental evaluations are conducted under 25%, 50%, 75%, and 100% motor load conditions. The results show that the HHO algorithm provides performance comparable to that of PSO; both algorithms exhibit fast convergence capabilities and can be effectively utilized in these estimation problems.

Keywords: In situ efficiency estimation, induction motor, HHO, PSO

PARAMETRE TANIMLAMA KULLANARAK ASENKRON MOTORLARIN YERINDE VERIMLILIK TAHMINI

2. ÖZET

Üç fazlı asenkron motorlar geniş bir kullanım alanına sahip olduğundan, ayarlanabilir hız kontrol sistemlerinin uygulanabilmesi için parametrelerinin doğru bir şekilde tanımlanması büyük önem taşımaktadır. Bu doğrultuda, asenkron motor parametrelerinin hassas tahmini için uygun optimizasyon algoritmalarının seçilmesi gerekmektedir. Bu makalede, 2.2kW gücündeki üç fazlı asenkron motorun parametrelerini tahmin etmek için Harris Hawk Optimizasyonu (HHO) ve mühendislik uygulamalarında yaygın olarak kullanılan Parçacık Sürü Optimizasyonu (PSO) algoritmaları kullanılmıştır. Çalışma kapsamında, motorun eşdeğer devre parametreleri belirlenerek verim tahmini non-intrusive olarak gerçekleştirilmiştir. Amaç fonksiyonu, motor akımı, giriş gücü, güç faktörü ve anma çıkış gücü gibi ölçülen değerlerin hesaplanmasıyla tanımlanmıştır. Çalışmada, HHO ve PSO algoritmalarının yakınsama hızı ve parametre tahmin performansları karsılastırılmıstır. Deneysel değerlendirmeler %25, %50, %75 ve %100 yük koşulları altında gerçekleştirilmiştir.



Elde edilen sonuçlar, HHO algoritmasının PSO ile kıyaslanabilir bir performans sunduğunu, her iki algoritmanın hızlı yakınsama yeteneğine sahip olduğunu ve bu tür tahmin problemlerinde etkin bir şekilde kullanılabileceğini göstermektedir.

3. INTRODUCTION

The rapid industrialization of the global economy has led to an unprecedented surge in energy demand, exacerbating both environmental degradation and the strain on power systems. According to the International Energy Agency (IEA), the industrial sector accounts for 37% of global electricity consumption, with induction motors (IMs) alone responsible for over 68% of industrial energy usage [1]. These motors, which are the workhorses of modern industry, drive critical applications ranging from water pumping and HVAC (Heating, Ventilating and Air Conditioning) systems to manufacturing conveyor belts. However, their widespread use comes at a cost: inefficient operation of IMs results in terawatt-hours of wasted energy annually, contributing significantly to carbon emissions [2].

Enhancing the energy efficiency of induction motors has become fundamental to sustainable industrial practices. Although replacing older motors with high-efficiency ones (such as IE4 or IE5 class) can lead to significant savings, the primary challenge is to evaluate the efficiency of current motors accurately while they are in operation without needing invasive measurements. [3]. Traditional methods, such as direct torque measurement or dynamometer testing, require motor disassembly or specialized equipment, leading to costly downtime. Researchers have developed several indirect methods to estimate IM efficiency without mechanical interventions. Consequently, non-intrusive efficiency estimation techniques such as Nameplate, Slip Current, Equivalent Circuit, and Optimization-Based have gained prominence, balancing practicality with precision. Among these, optimization-based methods have shown remarkable potential due to their ability to handle nonlinearities and noisy data inherent in real-world systems. By treating parameter estimation as an optimization problem, these approaches bypass the need for direct mechanical measurements while achieving accuracies comparable to laboratory tests [4].

Optimization methods like Trust Region and Pattern Search have been effective, indicating that HHO could also be a viable alternative [5]. The Harris Hawks Optimization (HHO) algorithm, particularly its improved version, has been successfully applied to parameter identification in synchronous motors, demonstrating enhanced stability, convergence speed, and accuracy compared to other optimization methods. While the papers provided do not directly apply HHO to asynchronous motors, the principles and benefits observed in synchronous motor applications suggest potential applicability to asynchronous motor parameter estimation.[6]. A hybrid algorithm based on Particle Swarm Optimization (PSO) is proposed for more accurate and faster determination of parameters of induction machines. This algorithm provides advantages for real-time data processing by reducing the computational load compared to classical genetic algorithms [7].

In this paper, HHO and PSO algorithms are used for parameter estimation of three-phase induction motors. In particular, the ability of these two optimization algorithms to determine motor equivalent circuit parameters is compared for in-situ estimation of motor efficiency. In the study, experimental analysis on a 2.2 kW induction motor shows that HHO and PSO algorithms exhibit fast convergence properties, and the estimated efficiency values are quite close to the direct torque measurement method. The obtained results show that both algorithms are good alternatives for induction motor parameter estimation.



4. MATERIAL AND METHODS

Metaheuristic algorithms, such as Harris Hawks Optimization (HHO) and Particle Swarm Optimization (PSO), have revolutionized parameter identification in complex systems like induction machines. Unlike classical methods (e.g., genetic algorithms or gradient descent), HHO mimics the cooperative hunting behavior of Harris hawks, dynamically balancing exploration and exploitation to avoid local optima. Similarly, PSO emulates the collective intelligence of bird flocks, enabling rapid convergence toward global solutions. These algorithms excel in solving the ECM's underdetermined equations, where multiple parameter combinations can yield identical steady-state performance metrics [8,9].

Figure 1 shows an induction motor's general equivalent circuit diagram. R_1 and X_1 are stator resistance and reactance, R_2 , and X_2 are rotor resistance and reactance, X_m is magnetization reactance, R_{fe} is core loss resistance, s is slip, Pin, and Pout are input and output powers, P_{SLL} is leakage losses, and P_{FW} is wind and friction losses. This method determines unknown parameters to four (X_1 , X_m , R_{fe} and R_2)[10].

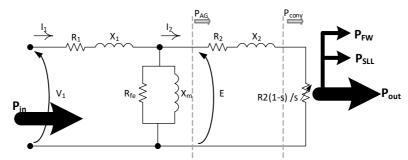


Figure 1-Induction motor equivalent circuit

 f_1 is the ratio of the measured input current and the real components of the estimated input current, f_2 is the ratio of the measured input current and the imaginary components of the estimated input current, f_3 is the ratio of the measured active input power and the estimated active input power, f_4 is the ratio of the measured reactive input power and the estimated reactive input power, f_5 is the ratio of the rated output power and the estimated output power [11].

$$f_1 = \frac{real(I_{1,meas}) - real(I_{1,est})}{real(I_{1,meas})}$$
(1)

$$f_2 = \frac{imag(I_{1,meas}) - imag(I_{1,est})}{imag(I_{1,meas})}$$
(2)

$$f_3 = \frac{P_{in,meas} - P_{in,est}}{P_{in,meas}} \tag{3}$$

$$f_4 = \frac{\varphi_{1,meas} - \varphi_{1,est}}{\varphi_{1,meas}} \tag{4}$$

$$f_5 = \frac{P_{out,meas} - P_{out,est}}{P_{out,meas}}$$
(5)



Fitness function $\gg ff_1 = |f_1| + |f_2| + |f_3| + |f_4| + |f_5|$

(6)

5. EXPERIMENTAL RESULTS AND DISCUSSIONS

HHO and PSO are used to determine the induction motor equivalent parameters, and the performance of these algorithms are compared. Three three-phase 380V, 4 pole, 50Hz, 2.2kW induction motor is selected. The nameplate data of this motor is given as full load current 5.3A, star connection, 1420 rpm, and Nema Design A. Table 1 shows No load and Locked rotor data of the induction motor. Only the data obtained from the experiments of the motor given in Table 2 were used for motor parameterization [12].

C I -INO ECOLO AND ECOLO I COLO I CALLO I UNE INCLUENTI						
	No Load		Locked Rotor			
	Pnl (W)	260	Plr (W)	760		
	Inl (A)	3,85	I _{lr} (A)	6,3		
	Vnl (V)	380	Vır (V)	117		

Table 1-No Load and Locked Rotor data of the induction motor

The parameter settings of the algorithms are the factors that directly affect the success of the optimization process. For the PSO algorithm, a particle count of 200 and 200 iterations were determined. As parameters, the inertia weight varies between a maximum of 0.9 and a minimum of 0.4, and the coefficients c1 and c2 are taken as 2. For the HHO algorithm, a population of 200 individuals and 200 iterations were used. In addition, the Lévy Flight Parameter (β) was determined as 1.5 and the Random Selection Factor (qr) as 0.5.

 Table 2-Loaded operating efficiency values of motors according to Direct Torque Method test reports

2.2 kW							
Load(%)	$\mathbf{V}_{1}(\mathbf{V})$	$\mathbf{I}_{1}(\mathbf{A})$	P _i (W)	Cos a	rpm (d/d)	$\mathbf{P}_{o}(W)$	Efficiency (%)
25%	380	3,69	820	0,42	1481	713	70,00
50%	380	3,99	1450	0,59	1464	1256	81,25
75%	380	4,35	1770	0,68	1454	1582	81,44
100%	380	5,07	2600	0,78	1424	2103	80,91

The algorithms need an initial value for the stator resistance R_1 . The other four parameters $(X_1, X_m, R_{fe}, \text{ and } R_2)$ will be determined through optimization algorithms. The fitness function in Eq. (6) was used to optimize parameters and estimate efficiency. The algorithms were run until a predetermined stopping criterion was reached. Figure 2 shows in detail the convergence behavior of the algorithms due to the efforts to find optimum efficiency. As can be seen from the figure, the HHO and PSO algorithms converge rapidly and nearly the same iteration number within a short period.

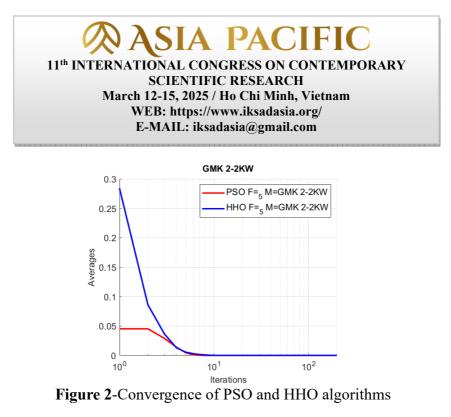


Table 3 shows the predicted motor efficiencies with Direct Torque Method and errors corresponding to different load points obtained for the motor. Figure 3 shows the efficiency errors of the results obtained from PSO and HHO algorithms. The efficiency errors of the PSO and HHO algorithms at the 75% and 100% load points are much lower, and the errors of both algorithms are very close to zero, while the error rate partially increases at other load points which are operating at a light load of 25% and 50%

GMK_2.2KW							
Load(%)	Direct Torque	IEEE 112-F	PSO	ННО			
Loau(70)	Method		est	error	est	error	
25%	70,04	70,2	72,03	-1,99	72,02	-1,98	
50%	81,25	78,8	80,5	0,75	80,46	0,79	
75%	81,44	80,8	81,81	-0,37	81,75	-0,31	
100%	80,91	80	80,6	0,31	80,51	0,4	

Table 3-Loading data of the motor according to the data obtained from the algorithms

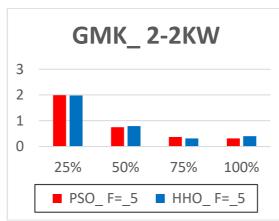


Figure 3-Efficiency errors of the results obtained from PSO, and HHO algorithms



Figure 4 compares estimated efficiency values with measured efficiency values using PSO and HHO. Each figure shows the performance of the algorithms for 2.2 kW motor. In each algorithm, when the load factor is 100%, the error rates are very low, while as the load factor decreases, the error rates increase. The predictions of the algorithms approach the measured values very closely, especially as the load increases. It is observed that the HHO algorithm reaches the minimum fitness value rapidly like the PSO. It is found that the algorithms perform successfully under both full and partial-load conditions. The results confirm the applicability of the algorithms used to optimize the equivalent circuit parameters of the motor. The result shows the performance of PSO and HHO algorithms in estimating the efficiency of an induction motor. PSO and HHO algorithms predicted similar efficiency values and gave results that were quite close to the measured values. It can be said that both PSO and HHO algorithms were successful in estimating efficiency, but HHO was very close to PSO and even better at some points.

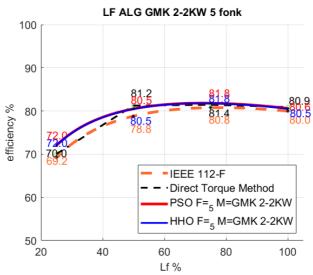


Figure 4-Efficiency errors of the results obtained from PSO, and HHO algorithms

Figure 5 shows the convergence graphs of X_1 , X_m , R_{fe} and R_2 parameters for the 2.2kw induction motor. In Figure 5, convergence reference values are shown according to the data obtained with the IEEE 112-F method. When the graphs are examined, it is seen that the X_1 , X_m , and R_2 parameters are very close to the values in the IEEE 112-F method in the PSO and HHO algorithms. However, the same situation is not valid for the R_{fe} parameter. It appears that the R_{fe} parameter estimation ranges are very wide. For the R_{fe} parameter, the HHO algorithm gave closer results. Of course, it should not be ignored that the R_{fe} parameter has little effect on the engine characteristics. In fact, it can be neglected in many studies.

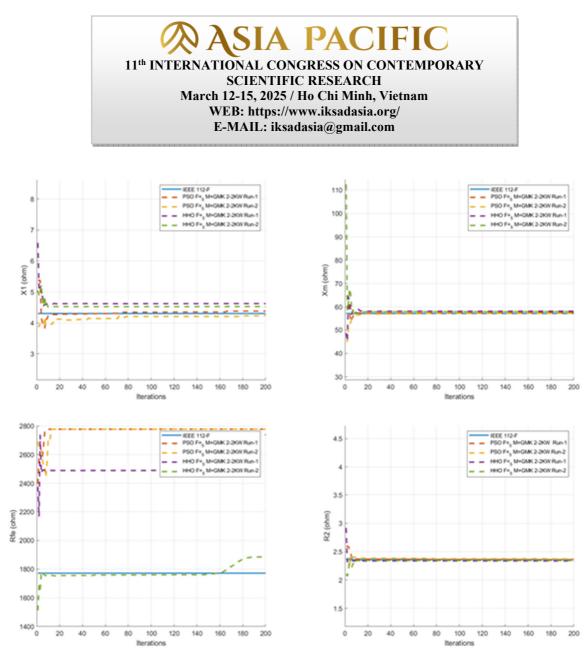


Figure 5-Convergence graphs of parameters at two run values of HHO and PSO algorithms

6. CONCLUSIONS

In this paper, the performances of Harris Hawk Optimization (HHO) and Particle Swarm Optimization (PSO) algorithms are compared for parameter estimation and efficiency estimation of a three-phase 2.2 kW induction motor. In the experiments, the efficiency obtained depending on the load levels of the motor are calculated as 72.02% and 72.03% with HHO and PSO for 25% load, 80.46% and 80.50% for 50% load, 81.75% and 81.81% for 75% load, and 80.51% and 80.60% for full load (100%), respectively. When the convergence speeds of the algorithms are examined, it is observed that both methods reach the optimum solution with a similar number of iterations. The results show that HHO and PSO algorithms provide effective and reliable methods for in-situ estimation of motor efficiency and parameters and therefore can be used in real industrial applications.

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INVESTIGATION OF PROPULSION SYSTEMS FOR HYPERLOOP

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ABSTRACT

Hyperloop is a high-speed transportation technology utilizing magnetic levitation and electromagnetic propulsion within low-pressure tubes. Propulsion system choices depend significantly on infrastructure and energy supply configurations. Internal capsule-based propulsion using batteries reduces infrastructure costs but increases weight and charging times, whereas infrastructure-based propulsion reduces capsule weight but raises infrastructure costs. This study explores intermittent and hybrid propulsion configurations that leverage the strengths of both approaches. It proposes systems where capsules accelerate via infrastructure propulsion and maintain speed through internal systems, with regenerative braking integrated. Various linear motor technologies (LSM, LIM, LRM) and hybrid combinations are evaluated for efficiency, cost, and compatibility with levitation systems. **Keywords:** Hyperloop, propolsuion, linear motor, energy efficiency, levitation.

HYPERLOOP İÇİN İTME SİSTEMLERİNİN ARAŞTIRILMASI

ÖZET

Hyperloop, düşük basınçlı tüpler içerisinde manyetik kaldırma ve elektromanyetik itme teknolojisini kullanarak yüksek hızlı ulaşımı hedefleyen bir taşıma teknolojisidir. Kullanılan itki sistemleri, altyapı ve enerji besleme düzenlemelerine bağlı olarak önemli ölçüde değişiklik göstermektedir. Kapsül içinde batarya kullanılarak gerçekleştirilen dahili tahrik sistemi altyapı maliyetlerini düşürürken, kapsül ağırlığını ve şarj sürelerini artırmaktadır. Altyapı temelli tahrik sistemi ise kapsülleri hafifletmekte ancak yüksek altyapı maliyetlerine sebep olmaktadır. Bu çalışma, farklı tahrik sistemlerinin avantajlarını bir araya getiren aralıklı ve hibrit sistemleri incelemektedir. Altyapı destekli ivmelenme ve kapsül içi sistemlerle hızın korunması esasına dayalı, enerji geri kazanımlı frenlemeyi de içeren hibrit aralıklı tahrik sistemleri önerilmektedir. Farklı lineer motor teknolojileri (LSM, LIM, LRM) ve hibrit kombinasyonları, verimlilik, maliyet ve kaldırma sistemleriyle uyumluluk açısından değerlendirilmiştir.

Anahtar kelimeler: Hyperloop, tahrik, lineer motor, enerji verimliliği, manyetik kaldırma.



INTRODUCTION

Traditional transport systems need new alternatives in terms of speed, efficiency and environmental sustainability. In this context, Hyperloop and Maglev (Magnetic Levitation Trains) stand out as future transport technologies that can travel at high speeds with low friction (Rana, 2020). Hyperloop is a capsule system that moves in a vacuum tube with magnetic levitation technology (Transportation Economics & Management Systems, 2020). It was first proposed by (Musk, 2013) and it was predicted that it could reach a speed of 1200 km/h thanks to its low air resistance. Although Hyperloop is considered to be cost-effective, the construction of long vacuum tubes and the sustainability of pressurization systems pose significant challenges. Factors such as maintaining the air pressure inside the tube, safety systems and energy efficiency affect the feasibility of Hyperloop (Adrian, 2023). One of the main transport principles of Hyperloop is the movement of capsules using linear motors. Different motor technologies such as linear synchronous motor (LSM), linear induction motor (LIM) and linear reluctance motor (LRM) are being evaluated in terms of both efficiency and cost (Hardt, 2020). However, continuous propulsion along the entire line leads to high energy consumption. Therefore, intermittent propulsion systems are proposed to accelerate the capsules at certain intervals and then advance in a low-friction environment (Senat, 2018). This study analyses the Hyperloop propulsion systems in the existing literature and presents the advantages and disadvantages of different types. This paper reviews existing studies and analyzes Hyperloop propulsion systems. Various motor types (LIM, LSM, LRM) are compared based on multiple criteria (energy efficiency, infrastructure cost, safety, etc.). Approaches for the proposed hybrid motor systems are outlined, and several example system topologies have been developed.

INTERMITTENT PROPULSION SYSTEMS

The intermittent propulsion systems (IPS) proposed in Hyperloop systems have been developed to reduce infrastructure costs and ensure energy efficiency. This system allows capsules to accelerate at regular intervals and then maintain their acceleration in an aerodynamic frictionless environment (Stubbing et al., 2020). It is only necessary to periodically apply thrust to compensate for the friction caused by the capsule's residual air resistance and slight pressure differences within the tube. Thus, the capsule maintains its target speed by traveling along the path in a 'push-drop-push' motion (Babazadeh et al., 2023). As a result, energy efficiency can be increased without the need for continuous operation of the propulsion systems. This system can reduce infrastructure costs and minimize maintenance costs.

Intermittent Propulsion Movement Stages

Hyperloop's propulsion system is analyzed in three basic phases of motion. The acceleration (launch) phase is the short phase in which the capsule is accelerated to a very high speed (\approx 1000 km/h) at the exit from the station or at the beginning of the journey. This phase has the highest thrust and power requirements. The cruise stage is the phase in which the capsule travels long distances with low or near-zero additional power due to the low resistance in the tube after reaching the target cruising speed. Here, enough intermittent thrust is required to compensate for slight friction and leakage losses. The deceleration (braking) phase is the part where the capsule is safely stopped before the destination (Nøland, 2021b). During deceleration, the propulsion motors are operated in generator mode to recover kinetic energy as electrical energy (regenerative braking).



This is a critical feature that improves energy efficiency. For IPS, high-power thrust is provided only in the acceleration and stopping zones, allowing the vehicle to drive freely in the intermediate zones. This approach involves placing powerful launch/braking motors integrated into the infrastructure in areas near the station, leaving the vehicle with only small thrusts or completely unresponsive during long travel sections. IPS can combine the advantages of onboard and infrastructure propulsion systems, combining the advantages of both systems (Sadeghi et al., 2022; Stubbing et al., 2020). The linear motor technologies LIM, LRM, LSM, and hybrid combinations suitable for Hyperloop can be comparatively analyzed within the scope of an intermittent propulsion scenario. In terms of operating principles, LIM induces eddy currents in the secondary by creating a magnetic field with a three-phase AC current and generates thrust by the interaction of these currents; also, since there is a slip between synchronous speed and vehicle speed, the force is generated by this slip. In contrast, LRM works on the principle of magnetic reluctance and provides motion by attracting the teeth on the ferromagnetic rail with a variable magnetic field; moreover, since the secondary part is a completely passive steel structure, it does not require additional conductive material. On the other hand, the LSM operates the magnetic fields synchronously, locking the magnets on the vehicle with the magnetic field wave in the infrastructure and generating direct thrust. Thus, it provides an efficient drive without slipping (Yücel & Karabulut, 2024). However, hybrid systems combine different motor types at certain stages to take advantage of the advantages of each; for example, while LSM is used in the infrastructure, LIM or LRM can increase the flexibility of the system by providing auxiliary propulsion on the vehicle.

Motors are divided into iron-core, air-core, slot, and slotless, and each has its advantages according to the application. Motor structures and features are given in Table 1 (Boduroğlu, 2019; Chevailler, 2006). Criteria such as infrastructure requirements, efficiency, and cost for each engine of the same structure and different types are evaluated under separate headings in Table 2.

Feature	Iron-Core LM	Ironless LM	Slotless LM	
Cost	Low	High	Lowest	
Y-Axis Force	Highest	None	Moderate	
Cogging Force	Highest	None	Moderate	
Force-to-Size Ratio	Best	Moderate	Good	
Thermal Characteristic	Best	Worst	Good	
Primary Weight	Heaviest	Lightest	Moderate	
Primary Mechanical Strength	Best	Worst	Good	

Table 1 Comparison of linear motor structures

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Table 2 Comparison of linear motor types							
Criteria	LIM	LRM	LSM	Hybrid			
Infrastructure Requirement	Low infrastructure cost; requires only a passive track		Infrastructure-driven; requires long primary motor	Balanced use of infrastructure and vehicle propulsion			
Efficiency	Low efficiency; losses increase at high speeds	More efficient than LIM but not as high as LSM	Highest efficiency; no slip loss	Optimized system selection ensures best efficiency			
Infrastructure Cost	, U		Highest cost; requires active motors along the entire track	Moderate cost; partially equipping the infrastructure with motors			
Vehicle Mass/Cost	Heavy motor and power electronics required	Moderate weight; contains copper and iron, close to LIM	Light vehicle; motor and battery are not onboard	Moderate weight; balances the advantages of both systems			
Fault Tolerance	· ·	1	Infrastructure failures can affect the entire system				
Air-Gap Sensitivity	Highly sensitive; 10 mm gap must be maintained			optimization can improve tolerance			

Table 2 Comparison of linear motor types

PROPULSION SYSTEM APPROACHES

Intermittent Propulsion System Approaches, four approaches and their combinations have been considered for Hyperloop propulsion systems. The first approach can be labeled as a 'Lightweight Capsule Solution, High-Cost Infrastructure' (LCS). In this scenario, all propulsion engines and power supply are on the rail, and the vehicles are only passively towed. For example, Transrapid (Germany/China) and JR SCMaglev (Japan) maglev train technologies use fully active rail LSM (Liu et al., 2022). This topology provides efficient propulsion even at the highest speeds but at a high infrastructure cost. Figure 1 shows the general structure of the system. Depending on the requirements of the application and the priorities of the system, long primary LIM (LP-LIM) or long primary LSM (LP-LSM) can be preferred as the primary (Nøland, 2021a).

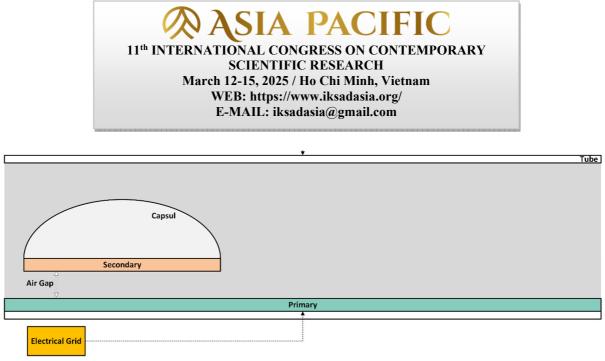


Figure 1 Long Primary Propulsion System

The second approach is defined as 'Low Infrastructure Solution, Heavy Capsule' (LIS). In this scenario, the rail is completely passive, and each vehicle provides its propulsion. The LIS approach makes track construction cheaper, but each capsule carries huge energy like a rocket. Studies have shown that a fully vehicle-powered hyperloop capsule (e.g. with a range of 1500 km) would need to carry out about 30% battery mass (Nøland, 2024). This is a rather large value, which, in practice, limits the capsule size and payload capacity. Nevertheless, the LIS approach is technologically feasible and may be attractive for short distances (e.g. <100 km). Figure 2 shows the overall structure of the system. Depending on the requirements of the application and the priorities of the system, short primary LIM (SP-LIM) or short primary LRM (SP-LRM) may be preferred.

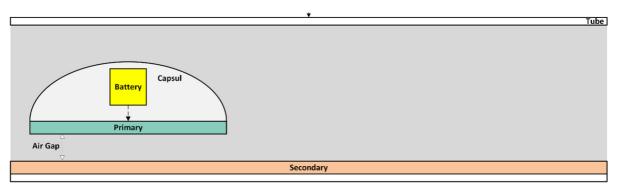


Figure 2 Short primary propulsion system

The third approach is the operation of the capsules with their own LIM; that is, the propulsion system is integrated into the vehicle. The difference in this system is that the energy is transferred wirelessly from the infrastructure via a magnetic system (Stubbing et al., 2020). A non-contact form of transmission is needed to reduce friction, but such a ready-made solution that meets both the speed and scale of Hyperloop does not yet exist. The general structure of this system, which still needs to be progressed, is shown in Figure 3.

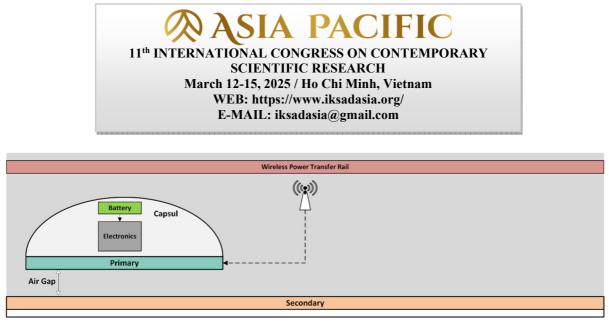


Figure 3 Short primary propulsion system with contactless power transfer

The fourth approach is the Intermittent/Hybrid propulsion system approach. In this topology, there are usually powerful linear motor segments supported by infrastructure at the exit and arrival from the stations. In these segments, vehicles are energized from the grid to launch or stop quickly and recover their energy. Passive traveling or low-power in-vehicle propulsion is planned for the remaining large central section of the road (Delft, 2022). Figure 4 shows the general structure of the hybrid intermittent propulsion system (Stubbing et al., 2020), Figure 5 shows the general structure of the system with booster zones, i.e., the system that accelerates the capsules by using linear motors only in certain areas, and Figure 6 shows the general structure of the system that initially launches and then maintains speed on the passive track with the vehicle-side motor.

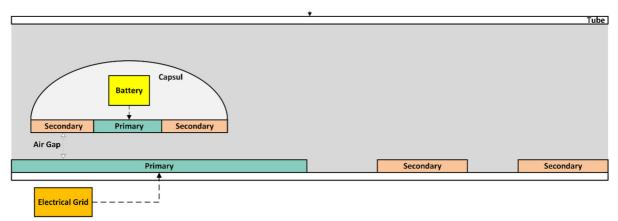


Figure 4 Hybrid intermittent propulsion system



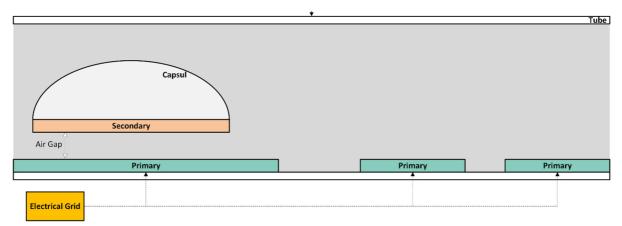


Figure 5 Intermittent propulsion system with booster stations

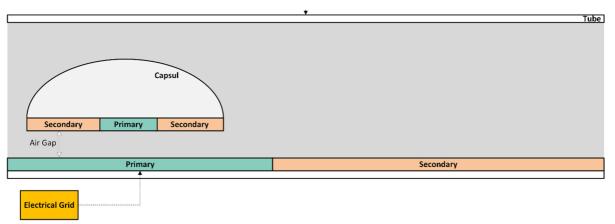


Figure 6 Velocity maintaining intermittent propulsion system

The type of motor to be used on the primary side, its layout, length, and frequency of movement are complex issues that must be determined depending on the requirements of the application and the priorities of the system. Factors such as the length of the route, targeted speed, travel time, vehicle weight, number of stations, and passenger capacity play a decisive role in this choice. These variables should be considered as key parameters in the optimization process to determine the appropriate propulsion system.

A SAMPLE APPLICATION

Based on the available information, many different propulsion system approaches can be used depending on the application. This study presents three examples of a Hyperloop propulsion system. In this proposed system, there are long primary LSM segments at station exits and entrances, as well as at intermediate-speed support points if necessary. Since these are short segments requiring high acceleration, efficient and powerful LSMs are used to maximize the speed of the capsules. The same systems operate in generator mode on arrival, feeding brake energy back to the grid. The LP-LSM is favored because it is efficient even at high speeds and does not add weight to the vehicle. Thanks to the allocation of the substation motors, for example, only acceleration in the first 50 km and booster stations every 50 km, the speed is maintained.



For the system shown in Figure 7, if a simpler system is desired instead of LP-LSM, a similar setup can be made with LP-LIM; however, the preference is in the second plan since the efficiency will decrease. In order to reduce the knocking and increase the propulsion force, double-sided and groove-free LSM is used. The vehicle travels on a rail suspended from the ceiling. This structure also supports the levitation system (Karabulut et al., 2024).

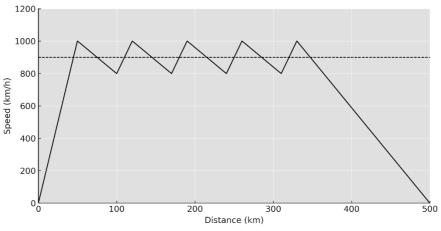


Figure 7 Velocity profile of example system-1

CONCLUSION

Hyperloop represents a promising high-speed transportation solution that integrates magnetic levitation and electromagnetic propulsion technologies within low-pressure tubes. This study investigated various propulsion system configurations ranging from internal capsule-based solutions to infrastructure-supported systems, highlighting intermittent and hybrid approaches as particularly advantageous. The analysis revealed that hybrid intermittent propulsion systems, combining infrastructure-based acceleration and capsule-based speed maintenance with regenerative braking, provide optimal balance among efficiency, cost-effectiveness, and reliability. Evaluations of different linear motor types (LSM, LIM, LRM) emphasized the importance of selecting configurations tailored to specific application criteria, including energy efficiency, infrastructure investment, and compatibility with levitation systems. Future Hyperloop implementations should, therefore, consider these hybrid propulsion strategies to achieve sustainable, scalable, and technologically viable transport solutions.

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DOES ELECTRONIC WORD-OF-MOUTH (E-WOM) IMPACT TRAVEL INTENTIONS? AN EVALUATION USING THE INFORMATION ADOPTION MODEL (IAM)

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Assistant Professor Jitender Kumar

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Abstract

The growing market competitiveness in commerce has positioned electronic word-of-mouth (eWOM) as a powerful tool for shaping consumer behavior across various industries, including tourism. This study aims to develop and assess a comprehensive conceptual framework that examines the impact of eWOM on travel intentions. Additionally, it explores the relationships among different dimensions of eWOM. Correlation analysis was conducted to examine these associations, while multiple regression analysis was employed to assess the effect of eWOM on travel intentions. The research model was tested empirically using a sample of 248 individuals who had previously used online travel services at least once. The results reveal that eWOM quantity has a stronger positive relationship with travel intentions compared to eWOM significantly influence travellers' intentions to travel.



WATERFALL MODEL OF SOFTWARE ENGINEERING TECHNIQUES

Assistant Professor Pramant Mahto

Srinath Universityv Adityapur

Abstract

The Waterfall Model is one of the earliest methodologies used in software engineering for software development. It is a linear and sequential approach where the process is divided into distinct phases. Each phase must be completed before moving on to the next, with no overlapping. The primary stages typically include Requirements Gathering, System Design, Implementation (Coding), Testing, Deployment, and Maintenance.

This model assumes that the requirements of the software are well-understood and fixed at the beginning of the project, making it suitable for projects with clearly defined and stable requirements. The Waterfall Model is easy to understand and implement due to its straightforward, structured approach. However, it is criticized for its rigidity and lack of flexibility when changes occur during the development process, as revisiting earlier stages is difficult and costly.

In conclusion, while the Waterfall Model may be effective for projects with static requirements, its lack of adaptability makes it less suitable for complex and dynamic projects where requirements might evolve over time.

Keywords: Waterfall Model, Software Requirement Specification (SRS), Design Phase Implementation, Testing, Operation and maintenance phase

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OPTIMIZING VEHICLE PERFORMANCE: THE IMPACT OF SENSORS ON ENGINE MANAGEMENT AND FUEL EFFICIENCY

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Abstract

The development of autonomous vehicles (AVs) is altering the transportation scene, with the potential to change the way we travel. Sensors are at the core of this transformation because they allow self-driving cars to sense their surroundings, identify problems, and make critical decision instantly. This research study offers a thorough analysis of the state of sensor technology in autonomous vehicles (AVs) today, emphasising the many kinds of sensors, their uses, and the difficulties associated with data processing and sensor integration. The study also explores the benefits and drawbacks of the main sensor modalities, such as lidar, radar, cameras, and ultrasonic sensors. Additionally, the study also examine how crucial sensor fusion and machine learning algorithms (MLAs) are to AVs' ability to comprehend and react to challenging situations. The importance of sensors in guaranteeing the security, effectiveness, and dependability of AVs is shown by our study, which also reveals important areas for further research and advancement. The advancement of sophisticated sensor technology will be essential to the AV industry's continued growth in order to facilitate the broad use of self-driving cars and fulfil their promise to revolutionise the transportation industry.

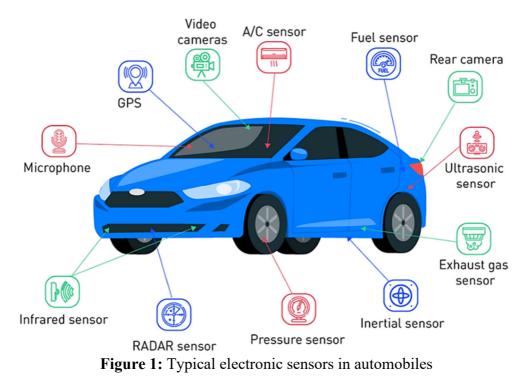
Keywords: Autonomous Vehicles, Self-Driving Cars, Sensors, Lidar, Ultrasonic Sensors.

1. Introduction

Advanced sensor technologies are crucial for modern cars' achieving maximum engine performance, enhancing fuel economy, and lowering pollutants. Real-time data gathering and accurate control over crucial factors like fuel injection, ignition timing, and air-fuel ratios are made possible by integrating sensors into engine management systems (Malik et al.,2024; Johnson & Joshi,2018). These technologies contribute to maintaining maximum efficiency and enhancing overall vehicle performance by continuously tracking engine parameters as well as external variables. Sensor-based systems are growing more complex as automotive technology advances, and they are essential for cost reduction, sustainability, and conformity to regulations (Lindgärde et al.,2015; Bassey et al.,2023).



To achieve optimal vehicle performance, this article examines how sensors affect fuel economy and engine management. For instance, electric vehicles (EVs), which are considered environmentally friendly because they generate little or no pollution when they are in motion, are rapidly gaining market share nowadays due to their growing usefulness, which is aided by recent technological developments, especially in the fields of energy storage and charging systems as seen in figure 1 (Melders et al., 2024; Tunnell et al., 2018). When compared to traditional cars with internal combustion engines (ICEs), the market share of electric vehicles (EVs) is anticipated to grow even more in light of recent changes to global emissions standards. The proportion of EVs in the global market share is projected to reach 32% by 2030, according to the most recent prediction by the International Energy Agency (Khaleel et al.,2024; IEA,2024; IEA,2023). The present study focuses on how to determine the primary sensor technologies that support engine management optimization and to ascertain which sensor technologies are most important for optimizing engine management systems. They will also explore how sensor performance and engine management optimization are affected by engine operating conditions. The study will go a long way in examining how sensor performance and engine management optimization are impacted by various engine operating circumstances.



2. Role of Sensors in Engine Management

Modern automobiles rely extensively on sensors to optimize engine performance, enhance fuel efficiency, and minimize pollutants. Often called the "brain" of the engine, the Engine Control Unit (ECU) gathers data in real-time from a variety of sensors and precisely modifies the air-fuel ratio, ignition timing, and fuel injection (Yaswanth & Babu,2024; Šarkan et al.,2022). This guarantees efficient functioning, improves output, and aids in adherence to environmental standards. Thus, the key sensors in Engine Management (EMS) and their roles are highlighted:



Sensor for Mass Air Flow (MAF)

The ECU receives data from the MAF sensor, which gauges the amount of air entering the engine. The MAF sensor aids in maintaining an ideal air-fuel ratio since air intake plays a crucial role in estimating the quantity of fuel needed for combustion. The engine might exhibit rough idling, low fuel efficiency, or interruptions in power if the sensor fails (Horning et al., 2018; Tutunea et al., 2018).

Sensor for Oxygen (O2)

An oxygen sensor is required to monitor the volume of oxygen in the exhaust gases. This sensor ensures that the engine maintains the proper air-fuel mixture (for gasoline engines, this is 14.7:1). The O2 sensor signals the ECU to modify the fuel supply if the mixture is too rich (excess fuel) or too lean (excess air). This enhances engine performance, boosts fuel efficiency, and lowers hazardous emissions (Rimpas et al.,2020).

Sensor for Throttle Position (TPS)

The TPS determines the throttle valve's angle and gives information about the driver's requested acceleration. This sensor guarantees a smooth throttle response and assists the ECU in regulating the amount of fuel injected. Unpredictable idling, poor acceleration, or reluctance might all be symptoms of a malfunctioning TPS (Humaidi et al.,2019; Hu et al.,2020).

The Knock Sensor

Engine knocking, which is caused by fuel burning unevenly in the cylinders, is detected by the knock sensor. Over time, knocking might harm the engine. The ECU modifies ignition timing and guards against damage using the knock sensor's data. To preserve engine longevity and guarantee smooth operation, this sensor is essential (Bares et al.,2018; Pla et al.,2020).

Sensor for Coolant Temperature

Besides helping control fuel injection and ignition timing, this sensor keeps an eye on the engine's coolant temperature. The ECU boosts fuel flow to facilitate combustion when the engine is cold. The fuel mixture is modified for increased efficiency once the engine has reached the ideal temperature. The engine may overheat, use less fuel, or have trouble starting in cold weather if this sensor malfunctions (Ahmed, 2020).

Sensor for Manifold Absolute Pressure (MAP)

To assist the ECU in determining engine load, the MAP sensor detects the air pressure in the intake manifold. This enables exact control over ignition timing and fuel injection, particularly in high-performance and turbocharged engines. Increased emissions, poor acceleration, and rough idling can all be caused by a malfunctioning MAP sensor (Wang et al.,2016; Cervantes-Bobadilla et al.,2023).

Position sensors for the crankshaft and camshaft

These sensors monitor the crankshaft and camshaft's position and rotational speed. This information is necessary to synchronize the timing of ignition and fuel injection. The engine may misfire, stall, or not start if either sensor malfunctions (Gaglio,2021).

Sensor for Exhaust Recirculation (EGR)

The EGR sensor helps lower nitrogen oxide (NOx) emissions by tracking the recirculation of exhaust gases into the intake manifold. To maximize engine performance and minimize pollution, the ECU modifies the EGR valve in response to sensor data. This EGR is an essential component in autonomous vehicles- These are vehicles that operate with limited human intervention as seen in Figure 2 (Nyerges & Zöldy,2020; Rešetar et al.,2022).

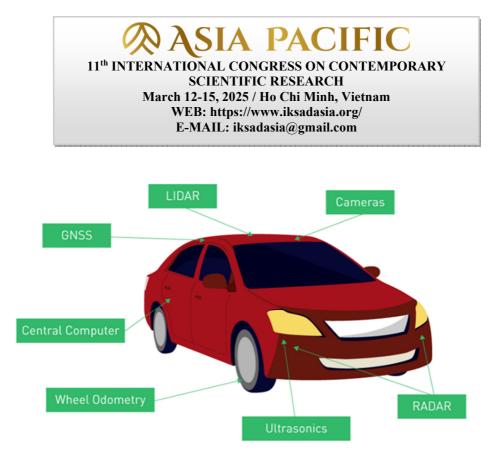


Figure 2: Autonomous vehicle sensors

3. Impact on Fuel Efficiency

Fuel efficiency has a significant impact on modern automobile design, influencing operating costs, environmental impact, and overall engine performance. Automotive sensors are essential for optimizing fuel consumption because they give the Engine Control Unit (ECU) real-time data that enables accurate modifications in fuel injection, ignition timing, and airfuel ratios. By continuously tracking engine conditions and adjusting for different driving environments, sensors such as these helps maximize miles per gallon (MPG) while decreasing emissions and wasteful consumption of energy (De Jong et al.,2021; Nonomura,2020).

Both adaptive fuel control and start-stop systems, which rely on sophisticated sensors to increase efficiency and decrease fuel waste, optimize fuel consumption in contemporary automobiles. By reducing needless idling and modifying fuel flow in response to current driving circumstances, these systems increase fuel efficiency and reduce emissions. An innovative technology called adaptive fuel control continuously modifies the fuel-air mixture in response to sensor inputs. Several sensors provide information to the Engine Control Unit (ECU), which decides on the best fuel injection plan for various driving circumstances (Romero etal.,2024; Yu et al.,2024).

4. Performance Optimization

Performance optimization strategies are used in modern cars to improve power output, efficiency, and the overall driving experience. Real-time tuning and diagnostics, which both make use of sophisticated sensor technology and processing capability, are two essential components of performance improvement. By enabling constant modifications to fuel injection, ignition timing, turbo boost pressure, and emissions management, these technologies guarantee that the car performs at its best under a range of driving circumstances (Amjad et al.,2018; Mazali et al.,2022).



4.1 Real-Time Tuning

Ali & Söffker (2018) observed that the capacity of a car's Engine Control Unit (ECU) to make rapid modifications to maximize engine performance is known as "real-time tuning." Sensor feedback loops enable this process by continuously supplying the ECU with data that enables it to precisely adjust in reaction to driver inputs, driving conditions, and engine load.

4.1.1 Key Components of Real-Time Tuning

Adjustments to the Air-Fuel Ratio and Fuel Injection

The ECU uses sensors including the Manifold Absolute Pressure (MAP), Oxygen (O2), and Mass Air Flow (MAF) sensors to dynamically modify the fuel-air mixture. For maximum fuel economy and combustion efficiency, the appropriate air-fuel ratio must be within 14.7:1 for gasoline engines and this ratio is maintained to achieve efficiency. ECU reconfiguration or tuning software enables real-time gasoline modifications for improved power output in high-performance applications (Chen et al.,2020).

Optimizing Ignition Timing

To avoid detonation which is otherwise known as engine knocking, the crankshaft position sensor and knock sensor aid in adjusting spark timing. Thus, innovative tuning techniques, like variable ignition timing, guarantee maximum power output while preserving engine safety and fuel economy remains an approach to maintain an efficient real-time tuning phase (Cao et al.,2024; Yun et al.,2023).

Boost control and turbocharger

For improved performance, numerous modern engines use turbochargers. The turbocharger wastegate is controlled by the Boost Pressure Sensor, which makes sure the right amount of boost pressure is applied. Real-time turbo tuning is made possible by electronic boost controllers, which permit modifications according to engine load and speed (Sjerić et al., 2016; He et al., 2018).

Adaptive Transmission Control

Adaptive transmission control guarantees smooth shifting, less lag, and optimal power delivery, enhancing total vehicle performance. Real-time tuning also applies to transmission systems, where sensors track gear shifts and throttle response (Quan et al.,2018; Liu et al.,2021).

5. Real-Time Diagnostics

Yadav et al (2021) and Sawant et al (2018) in their review studies opined that, to identify problems before they result in significant performance problems, real-time diagnostics continuously monitor the vehicle's systems. Sensor data and Advanced onboard diagnostics (OBD-II) systems work together to identify problems and make predictive maintenance possible.

5.1 Key Components of Real-Time Diagnostics

On-Board Diagnostics (OBD-II) System

When a malfunction is identified, the OBD-II system gathers sensor data and produces error codes, also known as diagnostic trouble codes or DTCs. This technology enables drivers and mechanics to use diagnostic scanners to troubleshoot engine issues (Yadav et al.,2021).

Fault Detection and Predictive Maintenance

Fault Detection and Predictive Maintenance: Early warnings of possible faults are given by sensors such as the exhaust gas sensor, oil pressure sensor, and engine temperature sensor.



Machine learning is used by AI-powered predictive maintenance systems to evaluate sensor data and forecast component wear and failure before they happen (Yadav et al.,2021).

Live Data Streaming and Remote Monitoring

In high-performance and racing applications, live data streaming enables real-time engine parameter monitoring. Fleet managers and manufacturers may remotely monitor the condition of their vehicles and plan maintenance with the use of telematics and Internet of Things-based monitoring (Yadav et al.,2021; Sawant et al.,2018).

The automotive industry is becoming dynamic as a result of performance optimization through real-time tuning and diagnostics. Thus, vehicle efficiency, power delivery, and reliability can be enhanced by through the deployment of sensor data, ECU modifications, and modern computer technologies. As such modern automobiles will continue to grow smarter and more efficient as technology advances, with real-time performance tuning becoming even more accurate and diagnostics moving toward AI-driven predictive maintenance (Gómez-Barroso et al.,2024).

6. Future Trends in Sensor-Based Vehicle Optimization

Dave (2021) and Kapoor et al (2023) observed that the developments in automation, artificial intelligence (AI), and sensor technology are influencing the direction of vehicle optimization. Modern sensors and real-time data processing are becoming essential to vehicle operations as automakers aim for increased performance, safety, and efficiency. Advanced Driver Assistance Systems (ADAS), sensor technologies for electric and hybrid vehicles, and AI-driven predictive analytics are the three main fields propelling this development.

AI-Driven Predictive Analytics (AiPA)

By utilizing big data, machine learning (ML) and the Internet of Things (IoT), there is a synergy that the connected sensors deploy to improve efficiency and dependability. This AI-driven predictive and analytics mechanism helps in the transformation of vehicle performance and maintenance. The Operation of AiPA is in sync with the real-time sensor data collection. For instance, the sensors in vehicles keep an eye on drivetrain parts, battery health, fuel consumption, and engine performance (Mandala et al.,2020; Cavus et al.,2025).

ML models

AI examines current and past data with the vehicle system to anticipate possible malfunctions or inefficiencies before they happen. The system is embedded in predictive maintenance alerts. Thus, the capability helps by informing drivers and service facilities when a component is likely to break, cars with AI-driven systems can lower repair costs and downtime. LiDAR Light Detection and Ranging (LiDAR) Sensors and radar are now embedded in the vehicle architecture, which creates 3-D mapping of the surroundings in a precise manner. The LiDAR system is not like the conventional camera system but a sophisticated system that is not affected by lighting conditions like darkness, glare or shadow. The sophistication makes vehicles embedded with LiDAR to be reliable in autonomous navigation (Cavus et al.,2025).

Electric and Hybrid Vehicle Sensor Technology

Ehsani et al (2018) and Husain (2021) opined that to maximize battery management, energy economy and its performance, and the vehicle's overall performance, a new generation of sensor-based technologies has been introduced through the smart transition to electric (EV) and hybrid (HEV) vehicles.



The EVs and HEV possess important sensors for Battery Management which help to prevent battery overheating or deterioration by keeping a monitoring eye on the temperature, voltage, and state of charge (SOC). Make it possible for hybrid systems to distribute energy among power sources intelligently. These sensors include:

Sensors for Regenerative Braking: When braking, there is a capture of the kinetic energy which is transformed into electrical power to recharge the battery. EV driving range may be increased by optimising energy recovery.

Sensors for Thermal Management: For optimum performance and lifespan of the EVs and HEVs, the battery is monitored and regulated at the right temperature to prevent overheating then regulating the cooling system to forestall any overheating challenges.

Sensors for charging and power distribution: The charging infrastructure is embedded to enhance the control of rapid charging to avoid overcharging and thermal damage. The system is structured and adapted to enhance effective power distribution.

7. Advanced Driver-Assistance Systems (ADAS)

Enhancing overall vehicle functioning and driving safety is the aim of Advanced Driver-Assistance Systems (ADAS) see illustration in Figure 3. It represents a significant development in automobile technology. These systems use a range of sensors, including LIDAR, RADAR, cameras, and ultrasonic sensors, to perceive the world around the vehicle and assist the driver in navigating and responding to various driving scenarios (Antony & Whenish,2021; Greenwood et al.,2021).

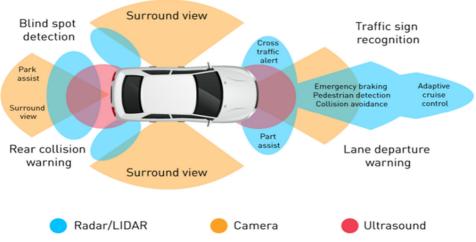


Figure 3: Illustration of ADAS Workability

8. Integrating Ultrasonic Sensors, LIDAR, Radar, and Cameras LIDAR

Light Detection and Ranging (LIDAR) sensors assess the distances between objects and produce detailed three-dimensional maps of their environment using laser beams. LIDAR is a great way to find the form and distance of an item, even in low-visibility conditions. Additionally, it is required for obstacle detection and avoidance, adaptive cruise control, and lane-keeping assistance.



High-resolution geographic data is essential for autonomous vehicles to safely traverse challenging environments (Kamiyama et al.,2019; Owoicho et al.,2021).

RADAR

Radio detection and ranging (RADAR) sensors use radio waves to identify objects and measure their distance, speed, and direction of motion. Although RADAR sensors can detect vehicles and objects in a range of weather conditions, including fog and rain, they serve as essential for blind spot detection, parking assistance, and accident prevention. They are commonly used in conjunction with LIDAR and cameras to improve the stability and reliability of ADAS (Wei et al.,2019).

Ultrasonic Sensors

These sensors use sound waves to determine the presence and proximity of objects. They are mostly used for parking assistance and low-speed obstacle recognition. They are particularly efficient at close-range detection and are crucial to systems that assist drivers in identifying curbs and other obstacles that may be out of their line of sight (Owoicho et al.,2021).

Cameras

Serving as the eyes of the ADAS, cameras capture images of the surroundings of the vehicle. Lane departure warnings, traffic sign recognition, and pedestrian identification all depend on them. Advanced image processing algorithms analyse the captured images to identify and track objects, assess road conditions, and provide input to the driver or control systems. The system's ability to understand complicated circumstances and make informed judgements is improved by the integration of cameras with other sensors (Yang et al.,2023).

9. Conclusion

The auto industry has witnessed an uncommon transformation ranging from engine management, fuel economy, and overall performance optimisation with the utilization of cutting-edge technology that is driven by numerous sensor systems. To ensure that vehicles run as efficiently as possible while utilizing less fuel and emitting fewer pollutants, the sensors are essential to fit into the vehicle architecture for their integration to provide real-time tuning, diagnostics, adaptive fuel control, and energy management. Additionally, the future of the auto industry is also being shaped by the development of AiPA, sensor technologies for EVs, HEVs and ADAS. While next-generation sensors in electric and hybrid cars optimise battery performance and range, AI-powered systems improve predictive maintenance, optimise energy consumption, and increase vehicle safety. Furthermore, ADAS advancements like computer vision, radar, and LiDAR are preparing the auto industry for another agenda which is an autonomous driving era.

Future automobiles will be smarter, safer, and more energy-efficient as sensor technology evolves in the auto industry. Driving economy and sustainability will be further improved by the further development of wireless battery monitoring, AI-based vehicle intelligence, and V2X (Vehicle-to-Everything) connectivity. The automobile sector is well-positioned to attain unprecedented levels of performance optimisation by using these advancements, opening the door for a future of intelligent, self-regulating, and environmentally friendly transportation.



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TENSILE TEST BEHAVIOR SIMULATION OF 3D-PRINTED MATERIALS : A G-CODE APPROACH IN ABAQUS

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ABSTRACT

This paper introduces a novel approach for simulating the tensile mechanical behavior of 3Dprinted materials using Abaqus, focusing on the Fused Deposition Modeling (FDM) process. The method extracts coordinate data directly from the G-code file generated by the slicer, enabling the reconstruction of the 3D geometry within Abaqus through a custom-developed tool. This tool accurately incorporates key FDM printing parameters, such as infill density, number of contours (infill walls), filament orientation, infill pattern, and layer height, ensuring high geometric fidelity. To validate the approach, tensile simulations were performed and compared with experimental mechanical tests, yielding correlation values of 96%, 94%, and 92% for filament orientations of 0°, 45°, and 90° in the elastic zone, and exceeding 90% in the elastoplastic zone. These results confirm the method's accuracy in predicting the mechanical behavior of FDM-printed materials under tensile loading, enhancing the reliability of finite element simulations in additive manufacturing.

Keywords: Additive manufacturing, fused deposition modeling (FDM), G-code, Abaqus, finite element analysis (FEA), tensile simulation, mechanical behavior.



MACHINE LEARNING TECHNIQUES FOR AUTOMATED FEATURE SELECTION IMPROVE MODEL EFFICIENCY, ACCURACY, AND INTERPRETABILITY

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Abstract

Automated Feature Selection (AFS) is an essential technique in Machine Learning (ML) that improves model accuracy and efficiency by selecting the most relevant features from large datasets. Various ML approaches, including filter, wrapper, embedded, and hybrid methods, help reduce redundancy and enhance interpretability. AFS plays a crucial role in applications such as medical diagnosis, fraud detection, and image classification by optimizing predictive performance. However, challenges such as computational cost and maintaining model generalization remain. This paper explores different ML techniques for AFS, their real-world applications, and potential advancements to improve feature selection processes.

Keywords: Machine Learning (ML), Automated Feature selection (AFS), Supervised Learning, Unsupervised Learning, Reinforcement Learning, Artificial intelligence (AI)

HERMİTE KOLLOKASYON YÖNTEMİNİN BİR MODEL PROBLEM ÜZERİNDE UYGULANMASI

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ÖZET

Doğada meydana gelen olayların matematiksel olarak incelenebilmesi ve yorumlanabilmesi için bir matematik formülü olarak düzenlenmesi gerekmektedir. Gerekli düzenlemeler sonrasında bu olaylar denklemlere dönüşerek uygun sınır şartları tayin edilir. Uygun sınır ve/veya başlangıç şartları altında alanına uygun bilim insanları bu tür problemleri ele alıp incelerler. İncelenen problemler başlangıçta, analitik çözümü bulunabilen problemler ve analitik çözümü bulunamayan problemler olarak iki kısma ayrılır. Bilim insanları çoğunluklada analitik çözümü olmayan bu tür problemleri incelerler. Ana amaç incelenen problemin analitik çözümü yoksa analitik çözümün yerine geçebilecek bir yaklaşık çözüm bulabilmektir. Yaklaşık çözüm bulma yöntemleri, çözüm bölgesinin tümünde işleme tabi tutan yöntemler veya çözüm bölgesini alt parçalara ayırma prensibine göre yaklaşık çözümü bulma esasına dayanmaktadır. Bu çalışmada sonlu elemanlar yöntemi kullanılarak çözüm bölgesi eşit uzunluklu alt bölgelere ayrılarak matematiksel işlemlere tabi tutulacaktır. Çözüm bölgesi üzerinde eşit parçalanma sonucunda elde edilen elemanlardan tipik bir eleman seçilerek, bu eleman üzerinde kollokasyon yöntemi uygulanarak Hermite B-spline bazları kullanılarak eleman denklemi oluşturulacaktır. Sonrasında bu denklem yapısı tüm eşit uzunluklu elemanlar üzerinde oluşturularak tüm bölge üzerinde bir cebirsel denklem sistemi elde edilecektir. Elde edilen cebirsel denklem sistemi üzerinde problem ile verilen sınır şartları kullanılarak çözülebilir bir cebirsel denklem sistemi elde edilecektir. Farklı konum adım uzunluklarında hata analizlerinin yapılabilmesi için günümüz modern bilgisayarlarından yararlanılarak elde edilen şemanın programı yazılacaktır. Programı günümüzde yaygınca kullanılan MATLAB sembolik programlama dili seçilerek yazılacaktır. Program çalıştırılarak elde edilen sonuçlar tablolar ve grafikler halinde çalışmada sunulacaktır.

Anahtar Kelimeler: Kollokasyon metodu, Hermite B-spline baz fonksiyonları, Sonlu Eleman Yöntemi.

HERMITE COLLOCATION METHOD IMPLEMENTATION ON A MODEL PROBLEM

ABSTRACT

In order for the events occurring in nature to be examined and interpreted mathematically, they must be organized as a mathematical formulae. After the necessary arrangements, these events are transformed into equations and appropriate boundary conditions are determined. Under appropriate boundary and / or initial conditions, scientists appropriate to the field handle and examine such problems.



The problems studied are initially divided into two parts: problems for which analytical solutions can be found and problems for which analytical solutions cannot be found. Scientists mostly study such problems that have no analytical solution. The main goal is to find an approximate solution that can replace the analytical solution if there is no analytical solution to the problem under study. Approximate solution finding methods are based on the principle of finding the approximate solution according to the methods that process the entire solution region or the principle of subdividing the solution region. In the present work, by using the finite element method, the solution region will be divided into sub-regions of equal length and subjected to mathematical operations. A typical element will be selected from the elements obtained as a result of equal partitioning on the solution region and the element equation will be formed using Hermite B-spline bases by applying collocation method on this element. Then, this equation structure will be formed over all equal length elements to obtain a system of algebraic equations over the whole region. A solvable system of algebraic equations will be obtained by using the boundary conditions given by the problem on the obtained system of algebraic equations. In order to perform error analysis at different position step lengths, the program of the obtained scheme will be written by using today's modern computers. The program will be written by choosing the symbolic programming language MATLAB which is widely used today. The results obtained by running the program will be presented in tables and graphs in the study.

Keywords: Collocation Method, Hermite B-spline basis functions, Finite Element Method.

INTRODUCTION

The phrase Finite Element Method (FEM) first was (Clough, 1960) coined by Clough in 1960. In the following years, thanks to the rapid development of faster and more capable digital computers, the finite element method has been used in many engineering and application fields. Thanks to this development in science and technology, researchers have witnessed many advances in the use of FEMs to find approximate solutions to complex mathematical and engineering problems in various fields of science. Scientists, engineers and especially mathematicians have utilized digital computers to solve differential equations using analytical methods. The main advantage of the application of the finite element method is its ability to transform the problem of solving the considered differential equation problem into the problem of solving algebraic equations corresponding to the original problem. The finite element method gives approximate functions on each element instead of approximate values at mesh points. In FEMs, the solution domain of the considered boundary value problem is generally divided into several 1D or more dimesional geometric regions widely known as finite elements. The regions at which those geometric shapes overlap are known as nodal or mesh points. The discretization process tries to find the numerical solution on each element instead of finding the solution on the whole solution domain of the considered problem at one step. Thus, firstly, by applying the existing method, element equations are obtained on typical elements over the solution domain and then those equations are combined to obtain a solution over the whole solution domain (Logan, 2007).

LITERATURE

In this section of the paper, a very few brief survey of the basis used in the approximation method and other problems that have been addressed in the literature with this basis will be presented.



First of all, an article for the singularity of cubic Hermite B-spline basis functions is written by Amat et al. (2023). Then, a non-linear problem based on cubic Hermite B-spline basis functiosn with a robust hybrid method is solved by Ayebire et al. (2024). In their work, Ayebire et al. have studied whether the newly presented scheme is stable or not by means of both of the error norms L_2 and L_{∞} . Ganaie and Kukreja have dealth with the numerical solutions of the Burgers equation on a test problem with the collocation FEM based on cubic Hermite basis functions (Ganaie, Kukreja, 2014). They have also shown that their scheme is unconditionally stable in temporal direction. Kumar (Kumar, 2024) has presented an application of cubic Hermite collocation technique on a differential equation. The author has presented the numerical results in tabular and graphical forms. An approximation analysis of the one dimesional heat conduction equation by means of cubic Hermite basis functions is investigated by (Kutluay, Yağmurlu & Karakas, 2022). The authors have shown that their newly obtained results are reliable and accurate by means of the calculated error norms and finally proposed that their method may also be utilized in successful manner in order to find out the numerical solutions of various nonlinear problems encountered generally in several branches of scientific fields.

Application of Cubic Hermite B-spline Collocation Method on Finite Element Method

In this study, collocation finite element method based on cubic Hermite basis functions will be used to find out the numerical solution of a prototype problem.

For an initial step, a polynomial of degree 3 as given below on the solution domain [0,1]

$$P(x) = ax^3 + bx^2 + cx + d$$

(1)

is taken into consideration. As it is obviously seen, the considered polynomial involves four unknown coefficients, namely a, b, c and d. Here the main goal is to be able to define these unknown coefficients in terms of the following terms

P(0), P'(0), P(1), P'(1).

When the considered polynomial P(x) is revised so that it is expressed only itself and its first derivative at the boundaries of the closed domain [0,1], then the unknown coefficients yield as follows

The unknown coefficients of the considered polynomial			
a = 2P(0) + P'(0) - 2P(1) + P'(1),	$\boldsymbol{b} = 3P(1) - P'(1) - 3P(0) - 2P'(0),$		
$\boldsymbol{c}=P'(0),$	$\mathbf{d}=P(0).$		

Since these values also should satisfy the equation itself, if the necessary fundamental calculations are performed in Equation (1), one obtains

 $P(x) = P(0)[1 - 3x^{2} + 2x^{3}] + P'(0)[x - 2x^{2} + x^{3}] + P(1)[3x^{2} - 2x^{3}] + P'(1)[-x^{2} + x^{3}]$

It is obvious that the newly obtained coefficients are the cubic Hermite basis functions themselves. On the Hermite basis functions, one can see the following articles and those therein (Kutluay, Yağmurlu & Karakaş, 2022).

The Hermite basis functions for Glo	bal Coordinate on solution domain [0,1]
$H_1 = 2x^3 - 3x^2 + 1$	$H_2 = x^3 - 2x^2 + x$
$H_3 = -2x^3 + 3x^2$	$H_4 = x^3 - x^2$

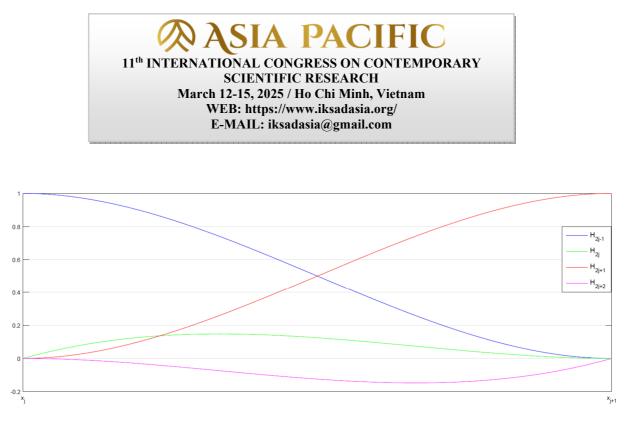


Figure 1. The illustration of 4 cubic Hermite B-spline functions on a typical element.

SHIFTED LEGENDRE AND CHEBYSHEV ROOTS

While utilizing Hermite basis functions, if one chooses cubic Hermite basis functions, then only 2 inner collocation points are considered. In order to minimize the error in the approximation, it has become a tradition to use the shifted Legendre and Chebyshev roots in place of these 2 inner collocation points. The values of these shifted roots are Legendre roots

$$\xi_1 = \frac{1}{2}(1 + \frac{1}{\sqrt{3}}), \quad \xi_2 = \frac{1}{2}(1 - \frac{1}{\sqrt{3}})$$

and Chebyshev roots

$$\xi_1 = \frac{1}{2} \left(1 + \frac{1}{\sqrt{2}} \right), \ \xi_2 = \frac{1}{2} \left(1 - \frac{1}{\sqrt{2}} \right).$$

(Ganaie, Kukreja, 2014). In the present study, the obtained results are presented in tabular form for both of the inner collocation points choices, and the notations \underline{L} stands for Legendre and \underline{C} stands for Chebyshev roots, respectively.

The prototype equation given below

$$\frac{d^2U}{dx^2} + U - x^2 = 0$$

having the following Dirichlet type boundary conditions is going to be considered.

$$U(0) = 0, \qquad U(1) = 0.$$

This Boundary Value Problem (BVP) has the following analytical solution

$$U(x) = 2\cos x + \frac{1 - 2\cos 1}{\sin 1}\sin x + x^2 - 2$$

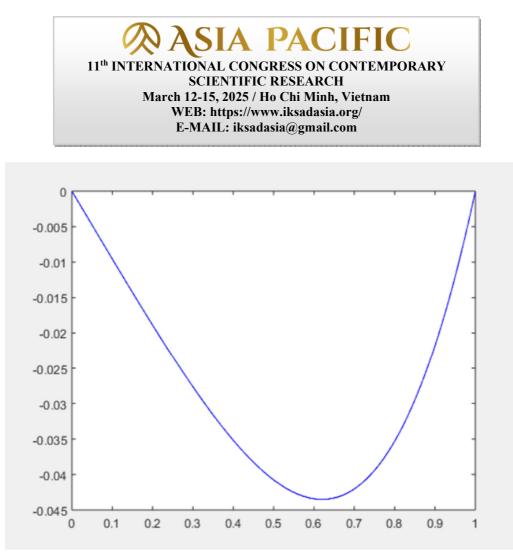


Figure 2. Exact solution of this boundary value problem on solution domain

After defining the prototype problem together with its boundary conditions and analytical solution, now one can use the collocation FEM utilizing cubic Hermite basis functions and find out approximate reults. One can use the following formula for the approximate solution over the whole domain of the problem

$$U_M = \sum_{j=1}^M a_{j+2k-2} \mathbf{H}_{ji}$$

 a_{j+2k-2} 's are unknown coefficients to be determined, k stands for the element number, and I stands for the inner collocation points, that is 1 or 2, and $H_{ji} = H_j(x_i)$'s stand for cubic Hermite basis functions.

The values of the function itself U_i and 2^{nd} order derivative U''_i calculated at the inner collocation points are given as follows, respectively

$$U_{i} = a_{2k-1}H_{1i} + a_{2k}H_{2i} + a_{2k+1}H_{3i} + a_{2k+2}H_{4i}$$
$$h^{2}U''_{i} = a_{2k-1}H''_{1i} + a_{2k}H''_{2i} + a_{2k+1}H''_{3i} + a_{2k+2}H''_{4i}$$

When those approximations are used in the governing equation, the following linear system of algebraic equations is obtained

$$[a_{2k-1}H''_{1i} + a_{2k}H''_{2i} + a_{2k+1}H''_{3i} + a_{2k+2}H''_{4i}] + [a_{2k-1}H_{1i} + a_{2k}H_{2i} + a_{2k+1}H_{3i} + a_{2k+2}H_{4i}] - (h\xi + x_k)(h\xi + x_k) = 0.$$



Now this newly obtained system of algebraic equations can not be solved uniquely. The boundary conditions are applied and a uniquely solvable system yields. After this simple and necessary step is applied, one obviously come to the conclusion that

$$a_1 = 0$$
 and $a_{2M+1} = 0$.

Now, one has a uniquely solvable and consistent system of algebraic equations as follows

$$La = R$$

where both of the Left hand and Right hand matrices are of $(2M \times 2M)$ and $(2M \times 1)$ type matrices. After solving this sytem of algebraic equations, one obtaines the unknown coefficients and this means that the approximate piecewise functions are also found out. Thus it is now easy to code and run the algorithm of the scheme for different values of spatial partition number M by meand of any symbolic programming language. In this study Matlab R2015a is used as means of sofwtware. The error norms L_2 and L_{∞} given below are used to test and control the efficiency and accuracy of the newly presented scheme

$$L_{2} = \sqrt{\left(h \sum_{i=1}^{M} |U_{i} - (U_{M})_{i}|^{2}\right)}$$

$$L_{\infty} = \max_{1 \le i \le M} |U_i - (U_M)_i|.$$

TABLE 1	L ₂		\mathbf{L}_{∞}	
Ν	L	<u>C</u>	L	<u>C</u>
4	1.1096e-05	3.1640e-04	9.2290e-06	3.0808e-04
8	6.9143e-07	7.8353e-05	5.7274e-07	7.6366e-05
16	4.3183e-08	1.9538e-05	3.5707e-08	1.9037e-05
32	2.6984e-09	4.8813e-06	2.2282e-09	4.7600e-06
64	1.6864e-10	1.2201e-06	1.3916e-10	1.1898e-06
128	1.0550e-11	3.0502e-07	8.6979e-12	2.9747e-07
256	5.8568e-13	7.6254e-08	5.3866e-13	7.4368e-08
512	4.0412e-13	1.9063e-08	3.9573e-13	1.8592e-08
1024	1.3568e-12	4.7657e-09	1.3533e-12	4.6478e-09
2048	4.2655e-12	1.1922e-09	4.2555e-12	1.1627e-09

When the values of the error norms L_2 and L_{∞} for increasing values M are investigated in Table 1, one can obviously see that the approximate solutions found out by means of Legendre roots are clearly much better than those found out by means of Chebyshev ones. Again one can conclude that increasing the values of spatial partition number M after a critical point, the approximate results deteriorate. We, as authors, think that this is due to round-off errors in the computational process of the computer.

CONCLUSION

When the newly obtained results are analyzed, it is seen that the applied method and basis can be easily applied in many branches of engineering and applied sciences. It is planned to apply the present method to many nonlinear, partial and fractional order differential equations in our ongoing and future studies.

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ACCELERATED CONVERGENCE FOR ELLIPTIC PDES: INTRODUCING THE SECOND REFINEMENT OF PARAMETRIC ACCELERATED OVER-RELAXATION (SRPAOR) ITERATIVE METHOD

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Abstract

This paper presents the Second Refinement of Parametric Accelerated Over-Relaxation (SRPAOR), a novel iterative method designed to solve elliptic partial differential equations (PDEs) efficiently. Building upon the existing Parametric Accelerated Over-Relaxation (PAOR) method, SRPAOR introduces a refined parametric strategy that adaptively adjusts the relaxation parameter to optimize convergence. Theoretical analysis and numerical experiments demonstrate that SRPAOR achieves significantly accelerated convergence rates compared to existing iterative methods, including PAOR and classical Accelerated Over-Relaxation (AOR). The SRPAOR method is particularly effective for large-scale, complex elliptic PDE problems, making it an attractive choice for various scientific and engineering applications.

Keywords: Accelerated Overrelaxation Method, Preconditioner, Convergence, spectral Radius

1. INTRODUCTION

In order to solve the system of n linear equations in n unknowns expressed in matrix form

Gt = b (1) where G is a nonsingular square matrix of size $n \times n$ with nonvanishing diagonal entries, t and b are unknown and known vectors respectively, we consider a usual splitting of G into its diagonal, strictly lower and strictly upper parts thus,

$$G = I - L - U \tag{2}$$

where -L and -U are the strictly lower and strictly upper parts of G respectively. It is assumed, for simplicity, that every diagonal entry of G is unity.



The Jacobi, Gauss-Seidel and successive overrelaxation (SOR) are some of the basic iterative methods for solving (1). They are defined respectively by the relations

$$t^{(n+1)} = \mathcal{L}_I t^{(n)} + k_I \qquad n = 0, 1, 2, \cdots$$
(3)

$$t^{(n+1)} = \mathcal{L}_G t^{(n)} + k_G \qquad n = 0, 1, 2, \cdots$$
(4)

and

$$t^{(n+1)} = \mathcal{L}_{\omega} t^{(n)} + k_{\omega} \qquad n = 0, 1, 2, \cdots$$
 (5)

where $\mathcal{L}_{I} = (L + U), k_{I} = c, \quad \mathcal{L}_{G} = (I - L)^{-1}, k_{G} = (I - L)^{-1}c, \quad \mathcal{L}_{\omega} = (I - \omega L)^{-1}\{(1 - \omega)I + \omega U\}, k_{\omega} = (I - \omega L)^{-1}\omega c$, for $0 < \omega < 2$. The accelerated overrelaxation (AOR) method introduced by Hadjidimos (1978) is a two-parameter generalization of the SOR method. Judicious exploitation of the two parameters involved leads to methods that will converge in minimal number of iterations than other methods of the same type. It has the representation

$$^{(n+1)} = \mathcal{L}_{r,\omega} t^{(n)} + k_{r,\omega} \qquad n = 0,1,2,\cdots$$
 (6)

where $\mathcal{L}_{r,\omega} = (I - rL)^{-1}[(1 - \omega)I + (\omega - r)L + \omega U], k_{r,\omega} = (I - rL)^{-1}\omega b$, for $0 \le r \le \omega < 1$. The matrix $\mathcal{L}_J = (L + U)$ is known as the Jacobi iteration matrix and its spectral radius is defined by

$$p(\mathcal{L}_{J}) = \bar{\mu} \tag{7}$$

For the Gauss-Seidel iteration matrix $\mathcal{L}_G = (I - L)^{-1}$, its spectral radius is found to be the square of spectral radius of Jacobi iteration matrix, that is,

$$(\mathcal{L}_G) = \bar{\mu}^2 \tag{8}$$

For matrices with certain properties, an optimum value for the relaxation parameter ω that appears in the SOR iteration matrix $\mathcal{L}_{\omega} = (I - \omega L)^{-1} \{ (1 - \omega)I + \omega U \}$ is governed by the relation

$$\omega = \frac{2}{1 + \sqrt{1 - \overline{\mu}^2}} \tag{9}$$

And for this choice of ω the spectral radius of the SOR iteration matrix is obtained as

$$\rho(\mathcal{L}_{\omega}) = \omega - 1 = \frac{1 - \sqrt{1 - \bar{\mu}^2}}{1 + \sqrt{1 - \bar{\mu}^2}}$$
(10)

The matrix defined by $\mathcal{L}_{r,\omega} = (I - rL)^{-1}[(1 - \omega)I + (\omega - r)L + \omega U]$ is the AOR iteration matrix whose spectral radius can be computed from the formula

$$\rho(\mathcal{L}_{r,\omega}) = \frac{\underline{\mu}\sqrt{\bar{\mu}^2 - \underline{\mu}^2}}{\sqrt{1 - \underline{\mu}^2}(1 + \sqrt{1 - \bar{\mu}^2})}$$
(11)

provided

$$0 < \underline{\mu} < \overline{\mu} \text{ and } 1 - \underline{\mu}^2 < \sqrt{1 - \overline{\mu}^2}$$
(12)

for the optimum values of ω and r

$$\omega = \frac{2}{1 + \sqrt{1 - \bar{\mu}^2}} \text{ and } r = \frac{\left(1 - \underline{\mu}^2\right) - \sqrt{1 - \bar{\mu}^2}}{\left(1 - \underline{\mu}^2\right)\left(1 + \sqrt{1 - \bar{\mu}^2}\right)}$$
(13)

respectively; where $\underline{\mu} = \min_{i} |\mu_{i}|$, $= \overline{\mu} = \max_{i} |\mu_{i}|$ and $\mu_{i}|i = 1(1)n$ define the eigenvalues of Jacobi iteration matrix $\mathcal{L}_{I} = (L + U)$.



Vatti et al. (2020) introduced two variants of the Accelerated Overrelaxation (AOR) method: the Parametric Accelerated Overrelaxation (PAOR) method and the Reaccelerated Overrelaxation (ROR) method, both designed for consistently ordered matrices. They build on these advancements by further enhancing the convergence properties of the AOR method through the development of a new variant called the Parametric Reaccelerated Overrelaxation (PROR) method. Isah et al. (2020) proposed the PROR method, which represents a three-parameter generalization of the Reaccelerated Overrelaxation (ROR) method, further advancing the capabilities of iterative techniques for solving linear systems. The classical AOR and PAOR method presented in their work for the solution of equation (1) are given as:

$$AOR = (I - wL)^{-1} \left\{ \left[(1 - r)I + (r - w)L + rU \right] x^{(n)} + rb \right\}$$
(14)

$$PAOR = [(1+x)I - wL]^{-1} \{ [(1+x-r)I + (r-w)L + rU] x^{(n)} + rb \}$$
(15)

Assefa and Teklehaymanot (2021) proposed a second refinement of the Accelerated Overrelaxation (AOR) method, which generalizes the method into a two-parameter refinement. Their work also derived optimal parameter values and extended the concept to the K^{th} refinement of accelerated methods. The spectral radius of the iteration matrix and the convergence criteria for the Second Refinement of Accelerated Overrelaxation (SRAOR) method were thoroughly analyzed. Audu (2024) introduces the Third Refinement of Successive Over-Relaxation (TRSOR) and Third Refinement of Accelerated Over-Relaxation (TRAOR) methods to improve the efficiency and convergence of solving linear systems. TRAOR is recommended over TRSOR for applications requiring high efficiency in large-scale linear systems. Many modifications and refinements have been reviewed as in (Ismail et. al., (2023), Vatti et. al., (2018), Eneyew et. al., (2019), Eneyew et. al., (2020), Abdullahi & Muhammad (2021))

When large sparse linear systems are involved, the method of choice is obviously iterative methods. However, the number of iterations needed for such methods to attain convergence could be relatively large. When such is the case, the need arises to remodel or redesign the existing methods so as to obtain approximate solutions that attain fast convergence. The aim of this paper is to introduce an advanced version of the Refined Accelerated Over-Relaxation (SRPAOR) method for solving the linear system (1). This new approach, termed the Second Refinement of Accelerated Over-Relaxation (SRPAOR) method, includes a discussion on the sufficient conditions necessary for its convergence.

MATERIALS AND METHODS

Formulation of Refinement of TRPAOR Method

The basic iterative method for the solution of system (1) can be expressed in the form

$$t^{(n+1)} = M^{-1}Nt^{(n)} + M^{-1}b, \quad n = 0,1,2, \quad (16)$$

Let Consider a usual splitting of the form
$$G = \frac{1}{r}(M - N) \quad (17)$$

Which implies that
$$rG = (M - N)$$

From (3.1)

$$Gt = rb \tag{18}$$

(20)

$$r\left(\frac{1}{r}(M-N)\right)t = rb\tag{19}$$

$$(M - N)t = rb$$

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 $N = \left[((1 + x - r)I + (r - w)L$ From equation (2.16) the M = [(1 + x)I - wL]and rU)] $\{[(1+x)I - wL] - [((1+x-r)I + (r-w)L + rU)]\}t = rb$ (21)[(1+x)I - wL]t - [((1+x-r)I + (r-w)L + rU)]t = rb(22)[(1+x)I - wL]t = [((1+x-r)I + (r-w)L + rU)]t + rb(23)[(1+x)I - wL]t = [(1+x)I - wL]t + r(b - Gt)(24) $t = t + r[(1 + x)I - wL]^{-1}(b - Gt)$ (25)From equation (25) the refinement of PAOR $t^{(n+1)} = t^{(n+1)} + r[(1+x)I - wL]^{-1}(b - Gt^{(n+1)})$ (26)where $t^{(n+1)}$ appearing in the RHS of (26) is the (n + 1)th approximation of PAOR method given by $t^{(n+1)} = [(1+x)I - wL]^{-1} \{ [(1+x-r)I + (r-w)L + rU]x^{(n)} + rb \}$ (27)Or $t^{(n+1)} = [(1+x)D - wL_G]^{-1} \{ [(1+x-r)D + (r-w)L_G + rU_G]x^{(n)} + r\tilde{b} \}$ (28)where, $L = D^{-1}L_G$, $U = D^{-1}U_G$, $b = D^{-1}\tilde{b}$ and $G = D^{-1}\tilde{G}$ Using the M and N to obtain the required iteration in (40) $t^{(n+1)} = t^{(n+1)} + r[(1+x)I - wL]^{-1}(b - Gt^{(n+1)})$ (29) $t^{(n+1)} = t^{(n+1)} + rM^{-1}(b - Gt^{(n+1)})$ (30) $t^{(n+1)} = t^{(n+1)} + rM^{-1}b - rGt^{(n+1)}$ (31) $t^{(n+1)} = t^{(n+1)} + rM^{-1}b - rM^{-1}(\frac{1}{n}(M-N))t^{(n+1)}$ (32) $t^{(n+1)} = t^{(n+1)} + rM^{-1}b - M^{-1}(M-N)t^{(n+1)}$ (33) $t^{(n+1)} = t^{(n+1)} + rM^{-1}b - M^{-1}Mt^{(n+1)} + M^{-1}Nt^{(n+1)}$ (34) $t^{(n+1)} = M^{-1}rb + M^{-1}Nt^{(n+1)}$ (35)But $t^{(n+1)} = M^{-1}Nt^{(n)} + M^{-1}rb$, put to equation (35) to obtained $t^{(n+1)} = M^{-1}rb + M^{-1}N(M^{-1}Nt^{(n)} + M^{-1}rb)$ (36) $t^{(n+1)} = M^{-1}rb + [M^{-1}N]^2t^{(n)} + (M^{-1}NM^{-1}rb)$ (37) $t^{(n+1)} = M^{-1}rb + [M^{-1}N]^2 t^{(n)} + [M^{-1}]^2 Nrb$ (38) $t^{(n+1)} = [M^{-1}N]^2 t^{(n)} + M^{-1}[M^{-1}N + 1] rb$ (39) But M = [(1 + x)I - wL] and N = [((1 + x - r)I + (r - w)L + rU)] $t^{(n+1)} = \left[[(1+x)I - wL]^{-1} [((1+x-r)I + (r-w)L + rU)] \right]^2 t^{(n)} + \frac{1}{2} t^{(n)} + \frac{1}{2$ $r[[(1+x)I - wL]^{-1}((1+x-r)I + (r-w)L + rU) + 1][(1+x)I - wL]^{-1}b$ (40)The method (40) is called the RPAOR method, $t^{(n+1)} = \mathcal{L}^{2}_{x,r,w} t^{(n)} + r(I + \mathcal{L}_{x,r,w} t^{(n)}) [(1+x)I - wL]^{-1} b$ (41)Remodeling (3.11) gives (3.27) $t^{(n+1)} = \mathcal{L}_{x,r,w}^{3} t^{(n)} + r(I + \mathcal{L}_{x,r,w} t^{(n)} + \mathcal{L}_{x,r,w}^{2} t^{(n)})[(1+x)I - wL]^{-1} b$ Equation (42) is the second refinement of Parametric Accelerated Overrelaxation method

 $\mathcal{L}^3_{x,r,w} = \left\{ \left[(1+x)I - wL \right]^{-1} \left((1+x-r)I + (r-w)L + rU \right) \right\}^3 \to SRPAOR \qquad \text{iteration} \\ \text{matrix} \qquad \text{iteration} \\ \end{bmatrix}$

CONVERGENCE OF SECOND REFINEMENT OF PARAMETRIC ACCELERATED OVERRELAXATION (SRPAOR) METHOD

Lemma 3.1 (Hadjidimos (1978)) If A is an irreducible matrix with weak diagonal dominance, then the methods of Jacobi, of Gauss-Seidel, of Simultaneous Overrelaxation, of Successive Overrelaxation and of Accelerated Overrelaxation converge.

Theorem 3.1 Let A be irreducible matrix with weak diagonal dominance. Then the refinement of PAOR method converges for any arbitrary choice of the initial approximation. **Proof:** Suppose t_* is the exact solution of linear system (3.1). Because matrix A is an irreducible matrix with weak diagonal dominance, the PAOR method is convergent by Lemma 3.1. Let $\hat{t}^{(n+1)}$ be the (n + 1)th approximation to the solution of (3.1) by the PAOR method (3.5). Then,

Since $||t^{(n+1)} - t_*|| \to 0$ and $||(\tilde{b} - \tilde{A}t^{(n+1)})|| \to 0$, we have $||\hat{t}^{(n+1)} - t_*|| \to 0$. Hence, the refinement of PAOR method converges to the solution of the linear system (3.1).

Theorem 3.2 Let *A* be irreducible matrix with weak diagonal dominance, then $||R_{\mathcal{L}_{x,r,w}}||_{\infty}^{3} = ||\mathcal{L}_{x,r,w}||_{\infty}^{3} < 1.$ **Proof:** Consider $||R_{\mathcal{L}_{x,r,w}}||_{\infty}$ then we have, $||R_{\mathcal{L}_{x,r,w}}||_{\infty} = ||[\{((1+x)I - wL)^{-1}[((1+x-r)I + (r-w)L + rU)]]\}]^{3}||_{\infty}$

$$= \left\| \left\{ ((1+x)I - wL)^{-1} \left[\left((1+x-r)I + (r-w)L + rU \right) \right] \right\} \right\|_{\infty}^{4}$$
$$= \left\| R_{\mathcal{L}_{x,r,w}} \right\|_{\infty}^{3} < 1 \text{ by Theorem 3.1}$$

Theorem 3.3 If A is irreducible matrix with weak diagonal dominance, then $||R_{\mathcal{L}_{x,r,w}}||_{\infty} < ||\mathcal{L}_{x,r,w}||_{\infty}$.

Proof: By Theorem 3.2, we have $\|R_{\mathcal{L}_{x,r,w}}\|_{\infty} = \|\mathcal{L}_{x,r,w}\|_{\infty}^3 < \|\mathcal{L}_{x,r,w}\|_{\infty}^3$.

Theorem 3.4 The refinement of PAOR method converges faster than the PAOR method when PAOR method is convergent.

Proof: Let \overline{t} be the solution of linear system (3.1) obtained by the refinement of PAOR method (3.9) and \hat{t} be the solution of (3.1) obtained by the PAOR method (3.5). From (3.9), we get

$$\begin{split} \bar{\bar{t}} &= R_{\mathcal{L}_{x,r,w}} \hat{t} + \tilde{d} \\ \bar{\bar{t}} &= \mathcal{L}_{x,r,w}{}^{3} \hat{t} + \tilde{d} \\ \bar{\bar{t}}^{(n+1)} - \bar{\bar{t}} &= \mathcal{L}_{x,r,w}{}^{3} t^{(n)} + \tilde{d} - \bar{\bar{t}} \\ &= \mathcal{L}_{x,r,w}{}^{3} (t^{(n)} - \hat{t}) + \tilde{d} - \bar{\bar{t}} + \mathcal{L}_{x,r,w}{}^{4} \hat{t} \\ &= \mathcal{L}_{x,r,w}{}^{3} (t^{(n)} - \hat{t}) - \bar{\bar{t}} + (\mathcal{L}_{x,r,w}{}^{3} \hat{t} + \tilde{d}) \\ &= \mathcal{L}_{x,r,w}{}^{3} (t^{(n)} - \hat{t}) - \bar{\bar{t}} + \bar{\bar{t}} \end{split}$$

 $=\mathcal{L}_{x,r,w}{}^3\bigl(t^{(n)}-\hat{t}\bigr)$



Now,

$$\begin{aligned} \left\| \bar{t}^{(n+1)} - \bar{t} \right\|_{\infty} &= \left\| \mathcal{L}_{x,r,w}^{3} (t^{(n)} - \hat{t}) \right\|_{\infty} \\ &\leq \left\| \mathcal{L}_{x,r,w}^{3} \right\|_{\infty} \left\| (t^{(n)} - \hat{t}) \right\|_{\infty} \\ &\leq \left\| \mathcal{L}_{x,r,w} \right\|_{\infty}^{3} \left\| (t^{(n)} - \hat{t}) \right\|_{\infty} \end{aligned}$$

Therefore, by Theorems 3.1 and 3.2 the refinement of PAOR method converges faster than the PAOR method.

RESULT AND DISCUSSION

Various numerical test was executed to validate the superiority of the Second Refinement of Accelerated Overrelaxation scheme (SRPAOR) over PAOR, and AOR. The criteria for the convergence are that, the spectral radius of iterative matrix must be less than one

Problem Sample. (Source: Isah et al. (2022))

	(1	0	$\frac{1}{5}$ 71	$\left(\frac{1}{5}\right)$
<i>A</i> =	0	1	$-\frac{71}{10}$	$\frac{113}{10}$
А —	$\frac{16}{5}$	$\frac{1}{5}$	1	0
	2	$\frac{1}{5}$	0	1 /

The results for Problem Sample were performed with Maple 2019 to yield some comparison results. The reduction of spectral radii for the Refinement, and Second Refinement of AOR, PAOR when compared to the AOR, PAOR and proposed by Hadijimos (1981), Vatti et al., (2020a) scheme are shown in Table 1-4 respectively.

Table 1: Comparison of Spectral Radii for Methods			
Methods	Choice of Parameters	Spectral Radius	
AOR	$r = \frac{14}{3}, w = \frac{5}{3}$	0.7512951780	
PAOR	$x = \frac{-9}{10}, r = \frac{43}{125}, w = \frac{1}{6}$	0.5842556518	

$$\rho(J_{AOR}) < \rho(J_{PAOR}) < 1$$

Table 2: Comparison of Spectral Radii for Refinement MethodsMethodsChoice of ParametersSpectral Radius		
RAOR	$r = \frac{14}{3}, w = \frac{5}{3}$	0.564444444
RPAOR	$x = \frac{-9}{10}, r = \frac{43}{125}, w = \frac{1}{6}$	0.3413546667

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Table 3: Comparison of Spectral Radii for Second Refinement MethodMethodsChoice of ParametersSpectral Radius			
SRAOR	$r = \frac{14}{3}, w = \frac{5}{3}$	0.4240643894	
SRPAOR	$x = \frac{-9}{10}, r = \frac{43}{125}, w = \frac{1}{6}$	0.1994383932	
SIGNOR	$x = \frac{10}{10}, r = \frac{125}{125}, w = \frac{1}{6}$		

ASIA PACIFIC

DISCUSSION

The results from Tables 1 to 3 demonstrate the effectiveness of the Second Refinement of Parametric Accelerated Overrelaxation (SRPAOR) method in improving convergence rates for solving linear algebraic systems. Initially, the classical methods Accelerated Overrelaxation (AOR) and Parametric Accelerated Overrelaxation (PAOR) exhibited relatively high spectral radii, indicating slower convergence. Among the two, PAOR had the lowest spectral radius, suggesting better performance.

With the introduction of refinements, the spectral radii progressively decreased. The first refinement methods (RAOR and RPAOR) showed notable improvements, with RPAOR having the smallest spectral radius. The second refinement methods (SRAOR and SRPAOR) further enhanced convergence, reducing spectral radii even more, with SRPAOR leading in efficiency.

Overall, the results confirm that iterative refinements effectively enhance convergence by reducing spectral radii. The SRPAOR method, with the lowest spectral radius across all test cases, proves to be the most efficient iterative method for solving large-scale linear systems.

CONCLUSION

The spectral radius of an iterative method for solving linear algebraic systems is a critical factor in ensuring convergence, with smaller spectral radii leading to faster convergence. The primary objective of developing new iterative methods is to enhance the convergence performance of existing methods. In this research, we utilized refinement techniques to propose a Second Refinement of the Parametric Accelerated Over-Relaxation (SRPAOR) method for solving linear systems. Numerical experiments demonstrated that the SRPAOR method outperforms the AOR, PAOR, RAOR, RPAOR, methods in terms of convergence having the Smaller spectral radius.

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FIRST REPORT of CATHARANTHUS ROSEUS PHYLLODY DISEASE ASSOCIATED WITH CANDIDATUS PHYTOPLASMA TRIFOLII in RECREATION AREAS of MERSIN-TÜRKIYE

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ABSTRACT

Periwinkle (Catharanthus roseus) is an important perennial ornamental plant used in parks, gardens and refuges along the Mediterranean coastline of Türkiye. This study was conducted in 2023 to determine phytoplasma-related problems observed in periwinkles in recreational areas of Mersin-Erdemli district. Phytoplasma-specific symptoms such as phyllody, virescence, multiple shoot formation, general vellowing, general stunting and little leaf were observed in Periwinkle plants in parks. 30 symptomatic periwinkle plants were uprooted from recreational areas to prevent the disease from spreading to other ornamental plants. The uprooted plants were planted in large pots to inoculate healthy periwinkle plants under controlled climate room conditions and to use in other studies. Total nucleic acid isolation from all plant samples was performed according to the CTAB method. In polymerase chain reaction (PCR) studies, the presence of phytoplasmas was determined using universal primer pairs, R16F1/R16R0 for Direct-PCR and R16F2n/R2 for Nested-PCR. Positive bands were obtained in all symptomatic plants except for plants showing general yellowing. Three of the positive samples obtained were randomly selected and sequenced. The sequence results were analyzed in BLASTn, iPhyclassifier (virtual RFLP) and MEGA-X programs and it was determined that the samples were related to Candidatus Phytoplasma trifolii. After the sequences were aligned in MEGA-X program, they were trimmed and 1 isolate was uploaded to NCBI Genbank. Phylogenetic tree was created with the uploaded isolate and the other isolates selected from Genbank and the relationship status of the disease was revealed. In this study, Ca. Phytoplasma trifolii was detected for the first time in Catharanthus roseus plants in recreational areas of Mersin province according to the best knowledge.

Keywords: Ca. Phytoplasma trifolii, iPhyclassifier, periwinkle (Catharanthus roseus), Türkiye.

INTRODUCTION

Periwinkle or Madagascar flower (Catharanthus roseus) is an important perennial ornamental plant used in parks, gardens and refuges along the Mediterranean coastline of Türkiye. Periwinkle is also an anti-cancer herb and is known to be used in Chinese medicine to treatments for some diseases, especially diabetes.

Periwinkle, a perennial plant, is one of the ornamental plants commonly used in parks, refuges and gardens in the Mediterranean coastal provinces of Türkiye. In addition to being a perennial plant, it is an important test plant grown for use in biological indexing because it is an important indicator plant for phytoplasma diseases.

Phytoplasmas, which belong to the Mollicutes class of bacteria, are plant pathogens that localize in the phloem of plants and can be transmitted by vector insects, dodder, vegetative plant parts and seeds. It is known that phytoplasmas are widespread all over the world and cause significant losses in plants (Bertaccini 2007; Hogenhout and Music 2010).

Periwinkle is an important natural host of phytoplasma. Natural infections have been reported worldwide, either by spread or by experimental transmission through inoculation. In Central America, natural infection of phytoplasmas belonging to different groups in periwinkle has been reported (Villalobos et al. 2019). The aim of this study was to detect natural phytoplasma infection in periwinkle plants in parks and gardens in Mersin province, Türkiye.

MATERIAL AND METHODS

In September 2022, symptoms specific to phytoplasma diseases were observed widely in periwinkle plants in Saim Göküş Park, Erdemli district of Mersin province. Phytoplasmaassociated symptoms of phyllody, virescence, sterility, multiple shoot formation, little leaf, stunting and general yellowing were commonly detected in most plants (Figure 1). Thirty periwinkles showing symptoms were uprooted and brought to Hatay Mustafa Kemal University, Faculty of Agriculture and planted in large pots in controlled climate rooms.

These plants were kept alive for use in laboratory studies and T-budding grafting (Biological indexing) was performed to healthy periwinkle (*Catharanthus roseus*) plants grown under controlled conditions. Test plants (periwinkle) subjected to biological indexing also showed the same symptoms.

Leaf midribs of symptomatic plants were homogenized by grinding with liquid nitrogen. Nucleic acid isolation (DNA extraction) was performed according to the CTAB method. (Doyle and Doyle 1990). In two-step Polymerase Chain Reaction studies (Direct and Nested PCRs), universal primer pairs R16F1/R16R0 (Lee et al. 1994) for direct PCR and R16F2n/R16R2 (Gunderson and Lee 1996) for nested PCR were used. PCR studies were performed by diluting extracted DNA and direct PCR products at a rate of 1/30.

Positive bands were obtained in all symptomatic plants and 3 selected Nested PCR products were sequenced by BM Labosis (Ankara,Türkiye). Sequence results were evaluated and trimmed in the MEGA-X (Kumar et al., 2018) program. One sample was uploaded to NCBI-Genbank and accession number was obtained. Enzyme digestion of the sample was performed in the *i*PhyClassifier software (virtual RFLP, Zhao et al. 2009). According to virtual RFLP and Basic Local Alignment Search Tool (BLAST) analysis results, it was confirmed that the plants were infected with *Candidatus* phytoplasma trifolii (16Sr group VI). The relationship between the selected samples from the GenBank and the isolate obtained in this study was revealed in the MEGA-X program. The phylogenetic tree was produced with 1000 bootstrap replications using the neighbor-joining method. *Acholeplasma laidlawii* (Accesion number: FJ226570; Volokhov 2008) isolate was preferred as an outgroup.

RESULTS and DISCUSSION

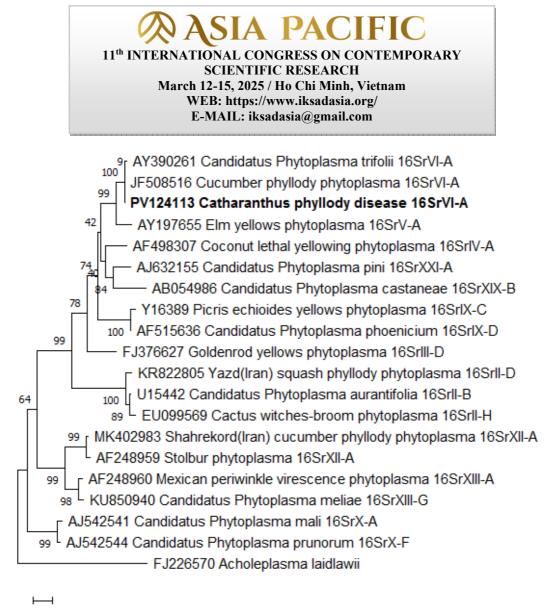
Periwinkle plants in parks and gardens in Mersin-Erdemli district exhibited symptoms related to phytoplasmas, such as phyllody, virescence, stunting, little leaf and yellowing (Figure 1).





Figure 1. Periwinkle plants taken from parks (A and B), planted in pots (D) and subjected to biological indexing (C).

Virtual RFLP, phylogenetic tree and BLASTn analyses showed that *Ca.* Phytoplasma trifolii was the responsible pathogen of periwinkle plants obtained from Mersin-Erdemli, Türkiye (Figure 2 and 3). The isolate obtained from the periwinkle plant showed 99.75% similarity with the reference strain "*Candidatus* Phytoplasma trifolii" (GenBank accession: AY390261; Hiruki and Wang 2004). In conclusion, in this study, phytoplasma belonging to 16Sr group VI-A subgroup were detected by sequencing and virtual RFLP in Mersin province, Türkiye.



0.020

Figure 2. The phylogenetic tree was constructed using the neighbor-joining method in MEGA-X software. Bootstrapping analysis was performed with 1,000 replicates. The isolate belonging to this study is shown in bold. *Acholeplasma laidlawii* (Accesion number: FJ226570) was used as the outgroup.

Phytoplasma diseases are widespread and increasing worldwide. Phytoplasmas have a wide host range and are known to cause significant economic and ecological losses of up to 100% in their hosts. (Bertaccini et al. 2014; Wang et al. 2022). As is the case all over the world, diseases caused by phytoplasmas are increasing in Türkiye. Çarpar and Sertkaya (2022a,b) reported that *Ca*. Phytoplasma trifolii agent was found in some cultivated plants and insect vectors in Hatay province.

Periwinkle, which can remain green in all seasons and has a long flowering period, is one of the ornamental plants widely used in parks and recreation areas along the coasts of the Mediterranean region of Türkiye. It is also an important host for phytoplasma diseases. When infected with phytoplasma, it constitutes a source of disease for other cultivated and ornamental plants grown in the region. Insects belonging to the Cicadellidae family in particular play an important role in the spread of this disease, but when continuous vector control cannot be carried out, the most effective way to combat the disease is to eliminate symptomatic plants.

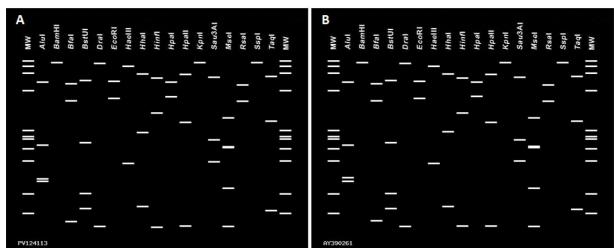


Figure 3. Virtual RFLP profiles of 16Sr gene fragments obtained from 16SrVI-A subgroup phytoplasma strain (PV124113) and the reference strain (AY390261).

Conflicting of Interests: There is no conflict of interest.

Human and animal rights: This article does not contain any studies with human participants or animals performed by any of the authors.

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GERMINATION, SEEDLING GROWTH AND CONTAMINTION OF ARONIA MITSCHURINII 'NERO' UNDER DIFFERENT pH IN VITRO

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ABSTRACT

This study aimed to determine the effect of pH which is one of the abiotic stress factors on the germination, seedling growth and contamination of Aronia mitschurinii A.K. Skvortsov and Maitul 'Nero' under in vitro. The experiment was carried out in Petri dishes moistened with distilled water adjusted to different pH levels at 5, 6, 7, 8, and 9. The experiment was monitored weekly for two weeks. The germination rate, root length, shooting rate, shoot length, and contamination rate were calculated and measured. The results showed that the germination rate, root length, shooting rate, and contamination rate were not affected by the used pH levels statistically. But shoot length was higher at pH 8 level than all used pH, especially than pH 5 statistically. At the end of the experiment when the results were examined in general, it was understood that the germination rate varied between 33.3-53.3 %, the root length varied between 0.53-0.90 cm, shooting rate varied between 33.3-53.3 %, and shoot length varied between 1.23-2.90 cm. The results also showed that although rooting was observed in the first week, shooting occurred in the second week. The results of this study are important in determining the germination and cultivation areas of the plant and in considering different germination procedures and propagation methods due to low germination rates. Keywords: Aronia sp., Acidity, Mitschurin Chokeberry, Germination, Seedling

INTRODUCTION

Soil acidity significantly impacts seed germination, influencing factors such as nutrient availability, enzyme activity, and overall seedling health. Acid rain cause soil acidity and this led to foliar necrosis, inhibition of seed germination, abnormal metabolic processes and retarding seedling growth in addition to predisposition plants to other biotic and abiotic stresses (Chao, 1995; Fan & Wang, 2000). Extreme acidity increases the availability of toxic elements like aluminum and manganese and decreases essential nutrients like phosphorus, calcium, and magnesium (Enesi et al., 2023). On the other hand, acidic soil suppresses beneficial microbes that help break down organic matter and release nutrients that cause slowing seedling development due to poor nutrient cycling. Some plant species are adapted to acidic soil as blueberry and high soil pH may have detrimental effects on photosynthesis and antioxidant system (Yang et al., 2022). On the other hand, it is also a possibility that it is not affected by soil acidity, and it may be a sign that it can show a wide geographical distribution and can be grown in many different soils.

When looking at the literature, it is possible to obtain information about the soil acidity required for many cultivated plant species. However, when looked at specifically, it is understood that these studies are not done for every plant species.



Aronia genus is one of these plants for which has quite insufficient studies have been conducted on germination or growth in different soil acidity. Aronia genus is a Rosaceae family and Maloideae subfamily plant (Campbell et al., 2007). The genus members are deciduous shrubs and native to eastern North America where has Aronia spp. in different ploidy levels (Brand et al., 2022). A. mitschurinii is not native formerly Russia Federation and Europe but actively cultivated in the countries as human origin with crosses F1 Sorbus aucuparia and Aronia melanocarpa hybrid, backcrossed A. melanocarpa (Leonard et al., 2013). Aronia mitschurinii is grown extensively in orchards in Scandinavia, Russia, Eastern Europe mostly in Poland. 'Nero' is one the cultivar of the species (Brand et al., 2017).

In detailed reviews of *Aronia* spp., it was shown that there are lots of studies that found out different carbohydrates, dietary fiber, organic acids, vitamins, elements, and useful phytochemicals in aronia berries and juice (Kulling & Rawel, 2008; Jurendić & Ščetar, 2021; Green et al., 2022; Sharma et al., 2025). In addition, studies are being conducted on revealing the content of Mitschurin Chokeberry (*Aronia mitschurinii*) leaves (Trineeva & Pugacheva, 2024). Similarly, lots of detailed reviews showed that health benefits of the plant parts, especially leaves and fruits. From the studies, antioxidants, anti-inflammatory, anti-cancer, antibacterial, antifungal, and hepatoprotective activities of the *A. melanocarpa* or *A. mitschurinii* are understood (Brand et al., 2017; Sidor et al., 2019; Green et al., 2022; Negreanu-Pirjol et al., 2023). Considering this information, it is expected that efforts will be made to grow it all over the world and to cultivate it outside its natural or well-known growing areas.

It is also a fact that the positive and beneficial content and yield of the *A. melanocarpa* are closely related to the growing environment as soil and climate (Skupien & Oszmianski, 2007; Hwang & Thi, 2016). Most likely, this is also true for *Aronia mitschurinii*, which is closest to the *A. melanocarpa* (Leonard, 2011).

Hence all abiotic factors and environment must be tested because of reach the true decision. This study aimed to determine the effect of pH which may be one of the abiotic stress factors on the germination, seedling growth and contamination of *Aronia mitschurinii* A.K. Skvortsov and Maitul under *in vitro*.

MATERIAL AND METHODS

The seeds of *Aronia mitschurinii* A.K. Skvortsov and Maitul (Skvortsov & Maitulina, 1982) 'Nero', which are the main material of the study, were obtained from the last fruits which were harvested from a professionally grown aronia garden in Kocaeli city in Türkiye, on September 30, 2024. The seeds were stratified cold by moistening the peat 2 cm deep in the refrigerator at 4 °C degrees for two months. After two months, the seeds were placed in 6 cm diameter Petri dishes on December 1, 2024. Each pH application was carried out in three Petri dishes for three replications, and each Petri dish contained 5 seeds. pH adjustment in distilled water was made by pH-meter measurement adding 0.1 M NaOH and 0.1 M HCl using with micropipette. 10 mL of the solutions which are prepared pH 5, pH 6, pH 7, pH 8 and pH 9 were applied each Petri ones a week. It was measured and calculated by examining the germination rate (%), root length (cm), shooting rate (%), shoot length (cm), and contamination rate (%) features for 2 weeks. This study was carried out in a Completely Randomized Design with a total of 5 treatments (pH; 5, 6, 7, 8, and 9) and a total of 75 seeds/seedlings were used and calculated. Statistical analysis was carried out using SPSS 16.0.



A two-way ANOVA was done to determine differences among treatment groups for the measurements. Duncan's Multiple Range Test was also done to determine if differences between individuals were significant (p<0.05).

RESULTS AND DISCUSSION

Germination rate of the seed and root length of *Aronia mitschurinii* 'Nero' seedlings were not affected by water acidity. Germination rate varied between 26.7 % - 46.7 % at the end of the first week and 33.3 % - 53.3 % at the end of the second week. Germination continued in the second week except for pH 9. The best result, numerically even if not statistically, was in application pH 8 at the end of the experiment. Similarly, the best numerical result for root length (0.9 cm) was in application pH 8. The root length varied between 0.53 cm – 0.90 cm at the end of experiment.

Although the emergence rate of shoots did not occur in any application in the first week, it occurred between 33.3 % - 53.3 % at the end of the second week. It has been observed that these numbers are completely compatible with the germination rate and that every plant that can give root can also produce shoots. When root length was examined, it was seen that there was a statistically significant difference, and the best result was 2.9 cm in the pH 8 application. The farest statistical group was in the pH 5, which gave the lowest result with 1.23 cm.

In this study, which was carried out without any seed sterilization, the contamination rate increased over the weeks. In general, it is seen that contamination is a germination barrier. The lowest contamination rate resulted in the highest germination, rooting and shoot formation. From this perspective, seed sterilization may be necessary and pH application may need to be re-evaluated.

The results, in this case, provided information that pH is not an effective parameter in germination and seedling steps in growth environment where no sterilization is applied, and that this plant can be tolerant to wide pH ranges.

Thanks to its high adaptability, aronia plant can be grown in a wide range of soil types and pH ranges. Soils rich in organic matter, medium textured, well-drained, with a pH value of 6–6.5 are recommended for cultivation (Yurtkulu, 2021). In a study showing plant tolerance about fertilization with N-P-K to another cultivar of *Aronia mitschurinii*, no effective results were observed in flowering, fruit yield, fruit size or fruit quality (Lentz, 2022). In another publication it has been emphasized that it can adapt to different geographic regions (McKay, 2001). This may be a sign that it can adapt to different soil acidity.

CONCLUSION

The results, in this case, provided information that pH is not an effective parameter in a natural growth environment where no sterilization is applied, and that this plant can be tolerant to wide pH ranges. However, it should not be forgotten that there may be multiple interactions in natural growth environments such as soil and that such studies provide preliminary information and that studies should be continued in the natural soil environment.

Table 1. Effect of pH on seed germination rate and root length of Aronia mitschurinii 'Nero'

pH value	Germination Rate (%)		Root Length (cm)	
	1 st week	2 nd week	1 st week	2 nd week
pH 5		$46,7^{\pm 30,6}$ *		$0,87^{\pm0,55}$ *
pH 6	$26,7^{\pm23,1}$			$0,53^{\pm 0,50}$
pH 7	$26,7^{\pm11,6}$			$0,70^{\pm 0,36}$
pH 8	$46,7^{\pm11,6}$		$0,60^{\pm 0,27}$	$0,90^{\pm 0,17}$
pH 9	$33,3^{\pm 11,6}$			$0,87^{\pm0,06}$
Mean	$34,7^{\pm 15,9}$	$41,3^{\pm 21,9}$	0,49 ^{±0,25}	0,77 ^{±0,35}

*Means in each column are not significantly different by the Duncan Multiple Range Test at the P < 0.05 level of significance

Table 2. Effect of pH on shooting rate and shoot length of Aronia mitschurinii 'Nero'

pH value	Shooting Ra	Shooting Rate (%)		Shoot Length (cm)	
	1 st week	2 nd week	1 st week	2 nd week	
pH 5	$0,0^{\pm 0,0}$ *	46,7 ^{±30,1} *	$0,0^{\pm0,0}$ *	$1,23^{\pm 1,16}$ ** b	
pH 6	$0,0^{\pm0,0}$	$40,0^{\pm 40,0}$	$0,0^{\pm0,0}$	$1,53^{\pm 1,16}$ ab	
pH 7	$0,0^{\pm0,0}$	$33,3^{\pm 11,6}$	$0,0^{\pm0,0}$	$2,50^{\pm0,5}$ ab	
pH 8	$0,0^{\pm0,0}$	$53,3^{\pm 11,6}$	$0,0^{\pm0,0}$	$2,90^{\pm0,12}$ a	
pH 9	$0,0^{\pm0,0}$	$33,3^{\pm 11,6}$	$0,0^{\pm0,0}$	$2,60^{\pm0,17}$ ab	
Mean	$0,0^{\pm 0,0}$	41,3 ^{±21,9}	$0,0^{\pm 0,0}$	2,16 ^{±0,94}	

*Means in each column are not significantly different by the Duncan Multiple Range Test at the P < 0.05 level of significance

**Means followed by a common lowercase letter in the column are significantly different by the Duncan Multiple Range Test at the P < 0.05 level of significance

pH value	Contaminat	Contamination Rate (%)		
	1 st week	2 nd week		
pH 5	20,0 ^{±20,0} *	53,3 ^{±11,6} *		
pH 6	$23,3^{\pm 32,2}$	$46,7^{\pm 30,6}$		
pH 7	$33,3^{\pm 11,6}$	$60,0^{\pm 20,0}$		
pH 8	$20,0^{\pm 34,6}$	33,3 ^{±23,1}		
pH 9	$20,0^{\pm0,00}$	46,7 ^{±23,1}		
Mean	$23,3^{\pm 20,6}$	48,0 ^{±21,1}		

*Means in each column are not significantly different by the Duncan Multiple Range Test at the P < 0.05 level of significance





Figure 1. Aronia mitschurinii 'Nero'; (a) Fruits on the bunches, (b) Fruits sections, (c) Seeds

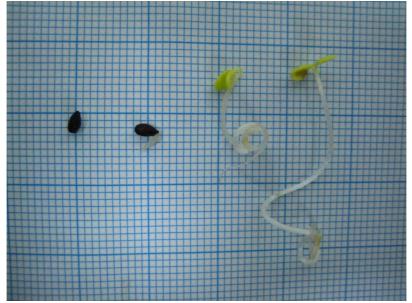


Figure 2. Seed germination and seedling steps of *Aronia mitschurinii* 'Nero' in Petri trial (each smallest square size is 1×1 mm)

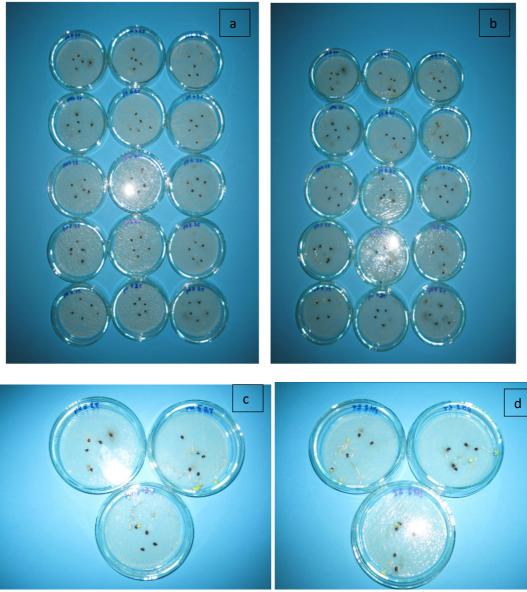


Figure 3. Aronia mitschurinii 'Nero'; (a) All treatments after 1st week, (b) All treatments after 2nd week, (c) Germination after the 2nd week at pH: 5, (d) Germination after the 2nd week at pH: 8

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CLONING, EXPRESSION, AND SEROLOGICAL EVALUATION OF RECOMBINANT FIBRONECTIN PROTEIN FOR THE DIAGNOSIS OF CYSTIC ECHINOCOCCOSIS IN SHEEP

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ABSTRACT

Echinococcus granulosus is a zoonotic parasite that causes Cystic Echinococcosis (CE) in humans and livestock. The adult parasites inhabit the small intestines of dogs, jackals, wolves, and other canids, while the larval form, the hydatid cyst, develops in various organs and tissues primarily the liver and lungs of sheep, goats, cattle, pigs, and many other domestic and wild mammals, as well as humans. Accurate diagnosis of CE in sheep is crucial for controlling the spread of infection and preventing economic losses. This study aimed to clone and express the fibronectin gene isolated from adult E. granulosus and to evaluate the diagnostic performance of the resulting recombinant protein in the serological detection of CE. For this purpose, primers were designed based on the E. granulosus fibronectin gene sequence available in GenBank (Accession no: AB458259.1) to amplify the fibronectin type 3 domain region (amplicon size: 480 bp). The cDNA obtained from adult parasites was amplified using the designed primers, cloned into the pET-30 vector, and expressed. The 17.12 kDa recombinant protein was then purified. The diagnostic efficiency of the purified recombinant protein was assessed by Western blot (WB) using positive and negative sheep sera. To determine the sensitivity of the test, serum samples from 72 sheep confirmed to have hydatid cysts during slaughter were analyzed. For specificity, 30 serum samples from newborn lambs were used. The results showed that the sensitivity of the WB test based on the recombinant fibronectin antigen was 75% (54/72), while its specificity was 100% (30/30). These findings indicate that the recombinant fibronectin protein has high specificity for the serological diagnosis of CE in sheep. However, the suboptimal sensitivity suggests that expressing and evaluating other domains of the gene could further improve its diagnostic potential.

Keywords: *Echinococcus granulosus*, Fibronectin, Serodiagnosis, Western Blot, Sensitivity, Specificity, Sheep,

PM2,5 KONSANTRASYONLARININ PM10 KONSANTRASYONLARI VE BAZI METEOROLOJİK PARAMETRELERE DAYALI TAHMİNİ

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ÖZET

Palandöken Dağı'nın eteklerinde denizden yaklaşık 1890 m yükseklikte bulunan Erzurum şehir merkezi 39° 92' kuzey enlemleri ile 41°30' doğu boylamlarına sahiptir. Türkiye'nin en yüksek rakımlı şehri aynı zamanda Kars – Erzurum platosu üzerinde kurulu 25 006 km²'lik yüzey alanı ile de ülkenin 4. büyük yüzey alanına sahip ili konumundadır. Sehirde yarı nemli, soğuk mikrotermal karasal iklim hakimdir ve Köppen-Geiger iklim sınıflandırmasına göre Dfb iklim tipi baskındır. Kışların uzun ve soğuk yazların kısa ve ılık geçtiği şehirde Meteoroloji Genel Müdürlüğü (MGM)'nün uzun vadeli istatistiklerine göre; hesaplanan yıllık ortalama sıcaklık 5.3 °C'dir ve en yüksek yağış miktarı ortalama 73,1 mm olarak Mayıs ayında gözlenmektedir. Aynı istatistiklere göre; yıllık yağışlı gün sayısı 121,8 ve toplam yağış yaklaşık 430,9 mm'dir. Ortalama güneşlenme süresi ise 7,0 saat olarak belirtilmektedir. Türkiye'nin en soğuk yerleşim yerlerinden birisi olan Erzurum'da toplam yerleşik nüfus yaklaşık 745 bin kişidir. Sanayi ve Teknoloji Bakanlığı'nın durum raporlarına göre 2019 yılında şehir, ülkenin 81 ilinin sosyo-ekonomik gelişmişlik endeksi sıralamasında 61. sırada yer almaktadır. 2021 yılı değerlendirmelerinde bu oran değişmemiş olup şehirde faaliyet gösteren sanayi işletmelerinin %55'i mikro ölçekli işletmelerdir ve tüm işletmelerin Türkiye'deki toplam sanayi işletmeleri içindeki payının yaklaşık %2,94 olduğu

bildirilmektedir.

Sanayideki düşük gelişme oranına rağmen, özellikle uzun ve sert kış mevsiminde ısınmadan kaynaklanan emisyonlar şehirde ciddi hava kirliliğine neden olmaktadır. Kentsel alanda binalarda ısınma amaçlı yakıt yakılmasından kaynaklanan emisyonlar yaklaşık 8 ay (Eylül – Nisan) devam etmektedir. Şehir merkezinde ve ilçelerinde bulunan 5 izleme istasyonu ile Çevre, Şehircilik ve İklim Değişikliği Bakanlığı'na bağlı Ulusal Hava Kalitesi İzleme Ağı'na veri beslemesi yapılmaktadır.

Bu araştırmada kullanılmak üzere Erzurum – Taşhan istasyonunun 10.01.2016 – 31.12.2022 tarihleri arasındaki kayıtları çevrimiçi olarak sağlanmıştır. Aynı periyottaki ortalama sıcaklık (*TEMP*, °C), nispi nem (*RH*, %), aktüel basınç (*PRES*, hPa), rüzgâr yönü (*WD*, °) ve hızı (*WS*, m/s)'na ait meteorolojik parametreler de MGM'den talep edilmiştir. Çalışmada $PM_{2,5}$ konsantrasyonunun, PM_{10} konsantrasyonu ve meteorolojik parametrelere bağlı olarak tahmin edilebilmesi için multiple lineer regresyon modelleri oluşturulmaya çalışılmıştır. Bütün parametreler günlük ortalama değerlerde olup veri seti toplam 2548 adet veri noktası içermektedir. Meteorolojik parametrelere kayıp veri bulunmamaktadır. PM_{10} ve $PM_{2,5}$ için kayıp veri oranı sırasıyla %4 ve %6 oranındadır. Veri setinin tamamında dağınık olarak bulunan bu kayıp değerler interpolasyonla tamamlanmıştır.

 $PM_{2,5}$; PM_{10} ve seçilen meteorolojik parametrelerin tümü kullanılarak üretilen Model 1; $PM_{2,5} = -357,41+0,63*PM_{10} - 1,04*TEMP - 0,06*RH + 0,44*PRES - 0,002*WD - 1,24*WS$ denklemi ile en yüksek regresyon katsayısında ($R^2 = 0,776$) yaklaşık %78 doğrulukla tahmin edilebilir.



Model 1'de en düşük katsayılara sahip rüzgar yönü ve hızı (0,002 ve 1.24) denklemden ayrı ayrı çıkarılarak elde edilen Model 2 ($PM_{2,5} = -362,13+0,63*PM_{10} - 1,04*TEMP - 0,06*RH + 0,45*PRES - 1,23*WS$) ve Model 3 ($PM_{2,5} = -416,79+0,64*PM_{10} - 1,07*TEMP + 0,07*RH + 0,51*PRES$), Model 1'in regresyon katsayısına oldukça yakın sırasıyla 0,775 ve 0,774'lik regresyon katsayıları üretilmiştir. $PM_{2,5}$ konsantrasyonlarının; seçilen meteorolojik parametrelere bağlı multiple regresyon analizinden sağlanan Model 4 ($PM_{2,5} = -1799,26 - 2,94*TEMP - 0,35*RH + 2,30*PRES + 0,006*WD - 3,45*WS$) için regresyon katsayısı 0,487 iken sadece PM_{10} konsantrasyonlarına bağlı olarak üretilen Model 5 ($PM_{2,5} = -10,93+0,78*PM_{10}$) için bu değer 0,723 olmuştur.

Çalışma periyodu aralığında Erzurum için; $PM_{2,5}$ konsantrasyonlarının sadece PM_{10} konsantrasyonlarına bağlı olarak yaklaşık %72 oranında, PM_{10} konsantrasyonları ve ortalama sıcaklık, nispi nem ve aktüel basınç parametreleri kullanılarak yaklaşık %78 oranında doğrulukla tahmin edilebileceği görülmüştür.

Anahtar Kelimeler: $PM_{2,5}$ konsantrasyonları, Kirlilik tahmini, Matematiksel modelleme, Meteorolojik parametreler

ESTIMATION OF PM2.5 CONCENTRATIONS BASED ON PM10 CONCENTRATIONS AND SOME METEOROLOGICAL PARAMETERS

ABSTRACT

Erzurum city center, located at the foothills of Palandöken Mountain at an altitude of approximately 1890 m above sea level, has 39° 92' north latitude and 41°30' east longitude. The city with the highest altitude in Turkey is also the 4th province in the country with a surface area of 25,006 km² established on the Kars-Erzurum plateau. The city has a semi-humid, cold microthermal continental climate and the Dfb climate type is dominant according to the Köppen-Geiger climate classification. In the city where winters are long and cold, summers are short and warm, according to the long-term statistics of the General Directorate of Meteorology (MGM); the calculated annual average temperature is 5.3 °C and the highest precipitation is observed in May with an average of 73.1 mm. According to the same statistics; the annual number of rainy days is 121.8 and the total precipitation is approximately 430.9 mm. The average sunshine duration is stated as 7.0 hours.

The total resident population in Erzurum, one of the coldest settlements in Turkey, is approximately 745 thousand people. According to the status reports of the Ministry of Industry and Technology, the city ranked 61st in the socio-economic development index ranking of the country's 81 provinces in 2019. This rate has not changed in the 2021 evaluations, and 55% of the industrial enterprises operating in the city are micro-scale enterprises, and it is reported that the share of all enterprises in the total industrial enterprises in Turkey is approximately 2.94%.

Despite the low development rate in industry, emissions from heating, especially during the long and harsh winter season, cause serious air pollution in the city. Emissions from burning fuel for heating purposes in buildings in urban areas continue for approximately 8 months (September – April). Data is fed to the National Air Quality Monitoring Network affiliated to the Ministry of Environment, Urbanization and Climate Change with 5 monitoring stations located in the city center and its districts.



In order to be used in this research, the records of Erzurum – Taşhan station between 10.01.2016- 31.12.2022 were provided online. Meteorological parameters of average temperature (*TEMP*, °C), relative humidity (*RH*, %), current pressure (*PRES*, hPa), wind direction (*WD*, °) and speed (*WS*, m/s) in the same period were also requested from MGM. In the study, multiple linear regression models were tried to be created in order to estimate $PM_{2.5}$ concentration depending on PM_{10} concentration and meteorological parameters. All parameters are daily average values and the data set contains a total of 2548 data points. There is no missing data in meteorological parameters. The missing data rate for PM_{10} and $PM_{2.5}$ is 4% and 6%, respectively. These missing values, which are scattered throughout the data set, were completed by interpolation.

Model 1, which was produced using $PM_{2,5}$; PM_{10} and all selected meteorological parameters, can be predicted with approximately 78% accuracy at the highest regression coefficient ($R^2 = 0.776$) with the equation $PM_{2,5} = -357,41+0,63*PM_{10} - 1,04*TEMP - 0,06*RH + 0,44*PRES - 0,002*WD - 1,24*WS$. By removing the wind direction and speed having the lowest coefficients (0.002 and 1.24) in Model 1 separately from the equation, Model 2 ($PM_{2,5} = -362,13+0,63*PM_{10} - 1,04*TEMP - 0,06*RH + 0,45*PRES - 1,23*WS$) and Model 3 ($PM_{2,5} = -416,79+0,64*PM_{10} - 1,07*TEMP + 0,07*RH + 0,51*PRES$) produced regression coefficients of 0.775 and 0.774, respectively, which are very close to the regression coefficient of Model 1. PM2.5 concentrations; The regression coefficient for Model 4 ($PM_{2,5} = -1799,26 - 2,94*TEMP - 0,35*RH + 2,30*PRES + 0,006*WD - 3,45*WS$) obtained from the multiple regression analysis depending on the selected meteorological parameters was 0.487, while this value was 0.723 for Model 5 ($PM_{2,5} = -10,93+0,78*PM_{10}$) produced depending only on PM_{10} concentrations.

It was observed that for Erzurum during the study period; $PM_{2.5}$ concentrations could be estimated with approximately 72% accuracy based only on PM_{10} concentrations, and with approximately 78% accuracy using PM_{10} concentrations and average temperature, relative humidity and current pressure parameters.

Keywords: $PM_{2.5}$ concentrations, Pollution estimation, Mathematical modeling, Meteorological parameters



GASTRONOMİ EĞİTİMİ ÜZERİNE BİR KRİTİK

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ÖZET

Gastronomi, yemek ve içmek kültürünü inceleyen bilim dalıdır. Yemek pişirme teknikleri, besinlerin kimyasal ve fiziksel özellikleri, tarihsel yemek kültürleri, yerel mutfaklar, restoran yönetimi ve yiyecek-içecek endüstrisi gibi konuları kapsamaktadır. Bu şekilde yalnızca yemek yapma sanatıyla sınırlı değildir; aynı zamanda yemek yeme deneyimini, sunumunu ve beslenme bilimiyle ilişkisini de ele alır. Oysa bu anlayış, üniversitelerde gastronomi bölümlerinde eğitimin damak ve mutfak anlayışının ötesine geçmeden olaylara tek yönlü baktığını göstermektedir. Meselâ gastronomide kullanılan "et" kelimesi daha başından itibaren anlaşılamaz dil halini almakta, bundan sonra "et" denildiğinde aklımıza kesilmiş ve öldürülmüş hayvan değil mutfak gelmektedir. Dolayısıyla, fırından veya tavadan nefis kokular çıkan yemeklerin damak tadıyla keyfe dönüşmesi gastronomi eğitiminde düşünsel boyutu gizlemektedir. Bu bildiri, insanın damağıyla tat aldığı gibi dimağıyla düşünmesini öne çıkarıp gastronomiye felsefi açıdan bakılması gereğini ön plana çıkarmaktadır.

Anahtar Kelimeler: Gastronomi, Eğitim, Mutfak, Hayvan, Et.

A CRITIQUE ON GASTRONOMY EDUCATION

ABSTRACT

Gastronomy is the branch of science that studies food and drinking culture. It covers topics such as cooking techniques, chemical and physical properties of foods, historical food cultures, local cuisines, restaurant management and the food and beverage industry. In this way, it is not just limited to the art of cooking; it also addresses the eating experience, its presentation, and its relationship to nutritional science. However, this understanding shows that education in gastronomy departments at universities looks at things from a single perspective, without going beyond the understanding of palate and cuisine. For example, the word "beef" used in gastronomy has become an incomprehensible language from the very beginning, and from now on, when we say "beef", we think of cuisine, not slaughtered and killed animals. Therefore, the fact that dishes with delicious smells coming from the oven or pan turn into a pleasure for the palate hides the intellectual dimension of gastronomy education. This article highlights the need to look at gastronomy from a philosophical perspective by emphasizing that people think with their "mouth" just as they taste with their "palate".

Keywords: Gastronomy, Education, Kitchen, Animal, Beef.

GİRİS

Damak tadı olarak gündelik hayatın içinde kullanılan tabir, mutfak sanatı (gurme) ismini alarak profesyonelleşmiş ve gastronominin konusu olmuştur. Beslenme olgusu zihinsel bilgi gerektirir ve bu da bedensel korunma ve beslenme alışkanlıklarını sürdürebilmeyi sağlar. Gastronomi kavramı bilim, sanat ve kültür boyutlarıyla ilgilidir. Damak tadı da bireyin yaşam deneyimleri, alışkanlıkları ve genetik yatkınlıkları tarafından şekillenir.



Bu yüzden beslenme alışkanlıkları sadece biyolojik değil aynı zamanda zihinsel bilgi ve öğrenme sürecinin de zorunluluğudur. Gastronomi eğitimi sadece damak ve mutfak uğraşısı ile yetindiğinde olayları tek yönlü ele alır. Fırından ya da tavadan nefis kokular çıkan yemeklerin damak yoluyla keyfe dönüşmesi düşünsel boyutu gizler. Ayrıca, yemek denildiğinde sadece bunun bir tüketim nesnesi değil; tarih, kültür, siyaset, kimlik, ekonomi ve bilimle iç içe geçmiş çok yönlü bir olgu olduğu da bilinmelidir.

Aslına bakılırsa insanın sadece "damağı" ile tat alması yerine "dimağı" ile düşünmeyi öne çıkarması bir lütuf değil bir gerekliliktir. Dolayısıyla gastronomiyi bu açıdan görmek ufuk açıcı gelişmedir. Ancak gastronomi eğitimi veren pek çok eğitmen ve öğrenci damak tadını tefekkür edebilmekten yoksundur. Dahası, felsefî boyuttan yoksundur. Gastronomi eğitiminin ağırlıklı olarak uygulamalı olması, öğrencinin de yemek kültürü, sofra adabı ve görgü kuralları gibi toplumdan topluma değişen kültürel ve sanatsal boyutu kavrayabilmesini zorlaştırmaktadır. En önemlisi de, mutfaktan çıkan "et" kavramının dilin çok yönlü boyutunu maskelediğinin farkına varamamasıdır. Meselâ Kahramanmaraş'ın meşhur tava yemeği *yanyana*, "sıkış tepiş" kelimeler arasında mesafeyi silip süpürmektedir. Yemek sadece tat alma duyusu değil, aynı zamanda kültürel ve dilsel metafordur. Ayrıca modern hayat karşısında gündelik hayatın zenginliği olan esnaf lokantaları moda tabirle "değer" olarak görülmesine rağmen, modern hayatın keşmekeşliği ve piyasa mekanizması içinde içten içe "alaturka" olmaktan da kendini kurtaramamaktadır.

Gastronominin verel ve evrensel turizme acılan kapısı elbette yadsınamaz. Her seve rağmen turizmi felsefî tahayyül yoluyla değerlendirmek zorundayız. Türk mutfağı ve kültürünü incelemek demek ona hak ettiği derinliği kazandırmak demektir. Bu yönüyle mutfak, başlı basına derin bir anlama gönderme yapmaktadır. Yerel ya da evrensel bir mutfağın tarihsel kökleri, kültürel etkileşimleri, bölgesel çeşitliliği ve yarattığı sosyal tabakaları zengin bir anlam dünyası içinden tahlil edilmelidir. Şimdilerde gastronomi bölümünde okutulan dersler damak tadından alınabilecek hazzı sadece kuşbaşı ve kuyruk olarak "bir zamanlar" koşup oynayan hayvanın bedeni olan "et" şeklinde ve sonuç hükmünde değerlendirmektedir. Sebzeler için de benzer yargıya varabiliriz. Bu durumda dil, anlamın sınırlarını belirsizleştirmekte, "yan yana" gelmekte, mesafeyi ortadan kaldırmaktadır. Meselâ mutfaktan sofraya gelen pekin ördeği, hayvanın hayvanî vasfını yok etmekte, sadece "yemek türü" olarak sofrava servis edilmektedir. Böylece gastronomi müfredatı o derece estetikten yoksun hale gelmektedir ki, "damak tadı" tabiri yalnızca keyif verici lezzetten başka bir şey sunmamakta, alınan tat ise düşüncel boyutu gizlemektedir. Gastronomide müfredat genelde teknik beceri ve reçete üzerine odaklıdır. Elbette bunun için teknik dersler olmalıdır; ancak bu sanat, felsefe ve kültürel eğitimle desteklenmelidir. Kaldı ki "damak tadı" tabiri yalnızca keyif verici lezzet deneyimi değildir, aynı zamanda sanatsal ve düşünsel algı biçimidir. Gündelik hayatta mutfak keyfi pekâlâ olacaktır. Fakat sorun şu ki, sürece önce buradan yani keyif kısmından başlanmakta, sonra da 'pişirmek' ve 'önden tatmaya' sıra gelmektedir.¹ Oysa buna hic gerek yok. Zaten uzun zamandan beri hayvanla dolaysız iliski kurmaya asina değil miyiz?² "Onları yiyerek!"

¹ Eco, *Prag Mezarlığı*, s.31.

² Singer, *Hayvan Özgürleşmesi*, s.167.



Yemek ve Sofra Kültürü: Görgü, Biçim ve Estetik

Norbert Elias, Uygarlık Süreci adlı kitabının birinci cildinde, geçmişte Batılı üst tabakanın sofra alışkanlığını "et" ile kurduğu ilişkiye bağlamaktadır. Bu ilişki, nezaketle görgünün ayrılmaz parçasıdır. Meselâ, Ortaçağ'da hayvan sofraya bütün olarak ya da büyük parçalar halinde getirilirdi. Balık, tüyleri yolunmamış kuş, tavşan, koyun ve çeyrek dana sofraya bütün halde gelir, genellikle yaban hayvanı, domuz ve sığır çevirmeleri yapılırdı. On yedinci yüzyıla kadar hattâ on sekizinci yüzyıla ait davranış kitaplarında iyi yetişmiş biri için hayvanın nasıl parçalanacağını bilmenin önemli olduğu anlatılır. Erasmus, 1530 yılında, "Cocukluktan itibaren parçalama tekniği öğrenilmelidir" diyordu. 1672'de Courtin, "Servis yapıyorsanız iyi parçaları başkalarına verin, daha az iyi olanları kendinize alın, eti çatalla tutun" seklinde ikâzda bulunuyordu.³ Benzer sekilde Johan Huizinga, adabı muaşeret meselesine önem atfedilmesini geleneğin güclü olduğu ve ilkel ruhun hâlâ hüküm sürdüğü her yerde bu meseleye dinsel anlamların atfedilmesiyle açıklandığını söylemektedir. Adabı muaseret kuralı asil bir oyun oluşturacak şekilde düzenlenmiştir. Bu oyun yüzeysel olsa da, henüz anlamsız bir geçit törenine dönüşecek kadar büsbütün yozlaşmamıştır. Geçmiş dönemde bazı durumlarda nazikçe ortaya konulan biçimsel kurallar önem kazanıyor, meselenin ağırlığı bir an için gözden kaçıyordu.⁴ Nezaket, cemiyete girince karşılıklı selâm ve saygıyla başlıyor, alışılmış iltifatlar, zorunlu baş ve el kol hareketleriyle devam ediyordu. Centilmen ya da hanımefendi olmanın zorunluluğu olan bu gibi ritüeller önce sofraya taşınırdı. İnsan eli fiziksel araç olmanın ötesinde, doğayla ve diğer canlılarla ilişkiyi şekillendiren önemli unsurdu. Tarih boyunca insan eli, yalnızca avlanma ve yiyecek tüketme aracı olmaktan çıkıp sosyal normların, görgü kurallarının ve estetik değerlerin belirleyicisi oldu. İnsan, elleri sayesinde aletler kullanıp yeme içme biçimini düzenledi ve böylece medeniyetin gelişiminde rol oynadı. Ancak bugün sofra kuralları ile genel olarak nezaketin sofradaki yansıması arasındaki ilişki biçimi değişmekte, yeni ve farklı usûl ve normlar benimsenmektedir. Dolayısıyla ayakta yeme alışkanlığının önem kazanmasıyla fast-food gibi ürünler de pratikte popüler hale gelmistir. Modern vasamın hızlanmasıyla birlikte avakta yeme alışkanlığının yaygınlaşması, "estetik" yoksunu olan pek çok "sentetik" ürünlerin hayatımıza girmesini sağladı. Fütursuzca işleyen piyasa mekanizması ise pahalı ürünlerin cebi, ucuz ürünlerin sağlığı tehdit ettiği kaçınılmaz bir gerçeği de gözler önüne sermektedir. Bu sekilde "beslenmek" tabiri de evrim geçirmekte ve yerini "doymak" tabirine bırakmaktadır. Dahası, doyuran ama beslemeyen ürünler de hayatımızın vazgeçilmezi olmaktadır.

Gastronomi ve Dil

Dil, hayvanın yokluğuna katkıda bulunurken etin anlamının önemli bir kısmını sabit bırakır:⁵ *Bir hayvan ölmeden önce kimse et yiyemez*. Öyle ya, öldükten sonra yenir..! İnsanın hayvan üzerindeki tahakkümü insan merkezli dünyanın problemidir. Hayvanın yaşam süresi, hakları ve iletişim olanaklarının kısıtlandığını şöyle tasarlayabiliriz. Ölmeden kısa bir süre önce konuşabilen hayvan şöyle demiş: "Özür dilerim! Nezaket kurallarını öğrenecek kadar vaktim olmadı." Aslında bu ifade, insanın hayvana karşı ne tür sorumluluk taşıması gerektiği üzerine derin bir düşünce içerir. Bu durumda nezaket, güçlü olanın zayıf olana karşı tavrını yansıtmaktadır.

³ Elias, Uygarlık Süreci I, s.216.

⁴ Huizinga, Ortaçağın Günbatımı, s.49.

⁵ Adams, *Etin Cinsel Politikası*, s.100.



Elbet hayvanın özür dilemesi ironidir; insan, kadim zamanlardan bu yana nezaketi ve inceliği kaybetmistir. Eğer hayvan gercekten konusabilsevdi, insandan hangi nezaket kurallarına uymasını beklerdi acaba? Her şey bir yana, adabı muaşeretin önemli ritüeli olan çatal bıçak kullanmanın önemi belki kendiliğinden ortaya çıkmış olabilir. Bugün gündelik hayatta kullandığımız pek çok kelime "et"in kaynağını gizlemektedir. Hiç kan görmeyiz; yaşayan, nefes alan, koşup zıplayan ve acı çeken hayvan ile ambalaja paketlenen hayvan arasında ilişki kurmayız. Bu aslında şehirleşme ve endüstriyel gıda üretiminin getirdiği algı değişimi olarak yorumlansa da, gerçekte, modern toplumda insanın hayvanla olan düşünsel bağının koptuğunu göstermektedir. Kuşkusuz gastronomi eğitimi bu bağı anlamak zorundadır. Ne var ki çoğu gastronomi kitapları kesilmeden önceki hayvanla değil, cesetlere dönmüş hayvanın "sofra güzelliği" ile övünür. Ne acı ki, böyle bir müfredat genel teamül halini almaktadır. Bugün "dolaysız" olsa da, geçmişte de nezaket kurallarıyla "dolaylı" şekilde dil maskeleniyordu. Yaşam yolculuğuna devam eden ve okyanusların en büyük balığı olan insan, besin zincirini henüz kontrolü altına almadan ve kalp çarpıntısından ölmeden kısa süre önce, sıcak ve Ay'sız bir gecede, birer çupura ile kaçınılmaz olarak bir büyük parlatırken bile o değişmez söylemi hecelemeye devam ediyor:6 "çupura bir insanlık mirasıdır!"

Dil, hayvanın bir dirim olan varlığını geri plana iterken, "et" kavramını sabit ve değişmez bir anlam çerçevesinde sunar. Dil sayesinde hayvanın bireyselliği ve canlılığı unutulmakta, yerine "gıda", "protein kaynağı" veya "tarifsiz lezzet" gibi kavramlar öne çıkmaktadır. Meselâ, "dana eti" ya da "kuzu eti" dediğimizde dil yoluyla hayvanın canlı olduğu gerçeği gölgede kalır ve hayvan yalnızca tüketim nesnesine dönüşür. Günümüzde "bitkisel bazlı et", "vegan burger" gibi terimler, dilin bu sabit anlamını nasıl esnetebildiğini göstermektedir. Dolayısıyla bu terimler "et" kavramını da merkeze almaktadır.

Reklâm, Cinsiyetsizleştirme ve Kuyruk Acısı

Bugün dişi hayvanın cinsiyetine yönelik algılar reklâmlar yoluyla ifşa edilmektedir. Bu sayede reklamlar toplumsal cinsiyet algısını şekillendirmektedir. Annelik, zarafet veya çekicilik gibi kavramlar dişi hayvan üzerine dolaylı olarak yansıtılmaktadır. Örneğin, 2016 yılında Kaliforniya'da Clover isimli Yunan yoğurdu piyasaya çıkmıştı. Reklâm panolarında toynaklı bir inek midye kabuğunun üzerinde duruyor, dalgalanan kırmızı kestanemsi renkteki tüyleri genital bölgesini kapatıyordu. Süt dalgaları ineğin iki yanında duran Clover yoğurt kaplarına çarpıyor, reklâm panosunda büyük harflerle "Yunan Mootolojisi" yazıyordu. Bu reklâm ilk bakışta Batıda kadın güzelliğinin arketipi olan Botticelli'nin *Venüs'ün Doğuşu* eserini anımsatır. Ama Botticelli'nin *Venüs*' ünde göğüsler vardı; bu büyükbaş hayvanın göğüsleri bile resmedilmemiş. Bu acaba hayvanın "iri beyinli yüksek memeli" grubuna girmemesinden dolayı mıdır, bilmiyoruz. Kesin olan şey hayvanın meme bezlerinin ve memelerinin görülmemesidir. Reklâmı yapılan yoğurdun çıktığı üreme organını gösteren her şey ortadan kaldırılmıştır. Böylece ineğin asli işlevi yok edilmiş, geriye yalnız hibrit bir dişillik kalmıştır. İşte "bu canlı" der Carol Adams, "kitabın orijinal kapağındaki resmin alternatifi kabul edilebilir çünkü bu dişi ne insan ne hayvandır."⁷

Bugün hayvan davranışını kesin olmasa bile imgesel düzeyde anlayabileceğimiz pek çok argümana sahibiz. Kuyruğun aşağıya sarkması durumunda hayvanın rahat olduğu, bacakların arasında olduğunda acı çektiği ya da korktuğu şeklinde anlatılardan bahsedilmektedir. Demek ki geçmişte olduğu gibi bugün de kuyruk acısı sürüyor.

⁶ Çaydamlı, KTN Kişisel Toplantı Notları, s.28.

⁷ Adams, *Ne Adam Ne Hayvan*, s.16.



Böylece dış dünyada ormanların gürbüz yerlisi "fiziksel kuvvet", Batı'nın toprağına ayak basan enerjik insanı da "şiddet" üretmeye devam etmektedir. Bu ikisinden doğan bileşim fiziksel açıdan aşağıdır ve geçmişin "kuyruk acısı" ile yüzyılların akışına terk edilmiştir. Aslında bu karşıtlık insanlığın geçmişten günümüze değin mücadelesini ve travmasını ima etmektedir. Eğer hayvan kendisine yaşattığımızın aynısını yaşatsaydı sonuç ne olurdu? Hiç. Çünkü Kartezyen düşüncenin öğeciklerden oluşan makina olduğu görüşüne o denli alıştık ki bunun metafor olduğunu bile unuttuk. Descartes gibi dünyanın artık saate benzediğini de düşünmüyor, dünyanın saat olduğunu düşünüyoruz. Öyleyse, Lawrence Ferlinghetti'nin mükemmel bir şekilde tasvir ettiği gibi:⁸ "hayatın kendisi bile kuyruğunu ısırmayı bırakmıyor."

Gastronomi ve Müfredat: Kritik Bir Derkenar

Türk üniversitelerinde gastronomi müfredatı bütünüyle yeniden hazırlanmalıdır. Ancak var olan derslerin yanına felsefe terimini eklemek sorunu çözmeyecektir. Amaç, derslerde 'felsefeyi değil, felsefe yapmayı öğrenmek; düşünceleri değil, düşünmeyi öğrenmek' olmalıdır. Aslında bu öğretimin de amacıdır: *düşünmeyi öğrenmek*. Derslerin yanına "felsefe" kelimesini eklemek yerine, gastronominin felsefesini anlamlandıran, öğrencilere yemek kültürü üzerine derinlemesine düşünmeyi öğreten dersler söz konusu olmalıdır. Bu hem sektöre daha bilinçli şefler kazandıracak hem de gastronomiyi sadece mutfakta değil, akademik disiplin olarak da güçlendirecektir. Ayrıca, bu şekilde gastronomi eğitimi sadece bilgi aktarmaktan ziyade öğrencilere *düşünme biçimi* kazandıracaktır.

Mevcut derslerin yanına "felsefe" kelimesini eklemek, gerçekte bir terimden fazlası olmayacaktır. Bu eğer birkaç ders koyup konuyu kapatmak anlamını taşıyorsa eğer yüzeysel çözüm sunmuş olacaktır. Asıl amaç, gastronomi öğrencilerinin eleştirel düşünme, analiz yapma, sorgulama ve yaratıcı düşünme becerilerini geliştirmektir. Meselâ bu konuda şu tarz sorular son derece öğreticidir: Toplumdan topluma yemek kültürü nasıl bir değişiklik göstermektedir? Hangi tatlar birbirine nasıl daha uyumludur? Osmanlı mutfağı neden bu kadar çeşitlidir? Modern toplum ve fast-food kültürü insanı doyurur mu, besler mi?

Bu anlamda gastronomi eğitimi yemek teknikleriyle sınırlı değildir; aynı zamanda kültür, tarih, sosyoloji ve ekonomi boyutlarını kapsar. Günümüzde birçok üniversitenin gastronomi bölümlerinde temel mutfak sanatları, gıda bilimi, beslenme gibi dersler yer almasına rağmen gastronomiyi bir bilim ve bir sanat dalı olarak derinlemesine irdelemenin hâlihazırda pek olası görülmediğini belirtmek zorundayız. Bu kısa vadeli yüzeysel bir çözümdür. Uzun vadeli gerçek bir çözüm ise ders içeriklerini değil akademik personeli kökten değiştirip yapılandırmakla mümkündür.

SONUÇ

Gastronomi, yemek ve içecek kültürünü inceleyen bilim dalıdır. Yemek pişirme teknikleri, besinlerin kimyasal ve fiziksel özellikleri, tarihsel yemek kültürleri, yerel mutfaklar, restoran yönetimi ve yiyecek içecek endüstrisi gibi konuları kapsamaktadır. Ne var ki gastronomi eğitimi damak ve mutfak terimlerine tek yönlü bakmaktadır. Çünkü sadece firindan veya tavadan nefis kokular çıkan yemeklerin damak tadı ile keyfe dönüşmesi düşünce boyutunu gizlemektedir. Üniversitelerin çoğu gastronomi bölümlerinde, müfredat programlarının görsel sofra kültürüyle sınırlı olması, gastronomi üzerine yazılan kitapların da, kesilmeden önceki hayvanla değil hayvan cesetlerinin "sofra güzelliği" ile öne çıktıklarını göstermektedir.

⁸ Ferlinghetti, *Küçük Çocuk*, s.66.



Gastonomi derslerinin estetik ve felsefeden yoksun olması dili de gizlemektedir. Reklâm ve piyasa odaklı dünya, ticari şirketlerin ürettiği cinsiyetsizleştirme politikalarını da gündeme taşımaktadır.

Her seyden önce gastronomiye politik söylemin çok ötesinden bakmalıyız. Kaldı ki etle ya da sebzeyle beslenmek, vegan ya da anti-vegan gibi politik bir akıl, bugüne dek hümanist yaklaşım ortaya koyabilmiş değildir. Dolayısıyla et yiyenlere düşmanca tavır almak anlamsız bir kör döğüşüdür. İnsanlık tarihi boyunca tüm "hümanist" yaklaşımlar ahlâki sonuç verebilseydi eğer, et yemeğe karşı çıkmamız kadar bitkileri yemeğe de karşı çıkmamız gerekirdi. Hattâ bir parça sütte ya da bir yumurtada, bir parça etteki kadar "acı" olduğuna inanmamız gerekirdi. Tabii durum böyle olmadığı için her gün sayısız türde bitkiler vejetaryenler tarafından katlediliyor. O vakit, 'yamyam' olmaktan vazgeçmeyi göze alan veganlar da gerçek mânâda "hümanist insan" olduklarını iddia edebilirler mi? Başka bir insanı yeme konusunda dürüst ve samimi davranıp açlıktan ölmeyi göze alabilirler mi? Ancak bu konuda cesurca bir davranış sergileyip vegan beslenmeyi savunan Zhanna Samsonova adlı bir sosyal medya fenomeninin yakın zaman önce açlıktan öldüğü açıklandı. Tropikal meyvalarla beslendiği için ölmüştü. Aslında bu durum coğrafyanın değil, genlerin kader olduğunu kanıtlayan çarpıcı gerçektir. Rus kökenli Samsonova, gergin derili ve soğuk toprakların kanını taşıyan bir gene sahip olduğu için bedeni tropikal kuşağın beslenme rejimine uygun değildi. Bu kadın, hayatında uzun bir süre egzotik meyvalarla beslenmişti. Öyleyse Samsonova, egzotik meyvaların katili olmalıdır. Ölümünden sonra sosyal medya takipçileri ise dualarını ironi yoluyla şöyle ifade ediyordu: "Mangosu bol olsun!" Hülasa, bir gün makinaların ve dijital hayatın boğucu ritmine karşı bir tür kendine dönük "yamyamlık" türeyecekse, insan da kendini yemeğe ve sindirmeğe elverişli hale gelecektir, diyebilir miyiz?

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11th ASIA PACIFIC INTERNATIONAL CONGRESS ON CONTEMPORARY SCIENTIFIC RESEARCH



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İLGİLİ MAKAMA

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