



## *PROCEEDINGS BOOK*

**MAS 17<sup>th</sup> INTERNATIONAL**  
**European Conference On Mathematics,**  
**Engineering, Natural & Medical Sciences**  
January 26-27, 2023  
Cairo, Egypt

**EDITOR:**

**Prof. Dr. Muhhamad Faisal**



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**MAS 17th  
INTERNATIONAL EUROPEAN CONFERENCE  
ON MATHEMATICS, ENGINEERING, NATURAL  
& MEDICAL SCIENCES**

**January 26-27, 2023**

**Cairo, Egypt**

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**Prof. Dr. Muhamad Faisal**

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# **CONGRESS ID**

## **TITLE OF CONFERENCE**

**MAS 17th  
INTERNATIONAL EUROPEAN CONFERENCE ON MATHEMATICS,  
ENGINEERING, NATURAL & MEDICAL SCIENCES**

## **DATE - PLACE**

**January 26-27, 2023  
Cairo, Egypt**

## **ORGANIZATION**

**IKSAD**

## **EDITOR**

**Prof. Dr. Muhhamad Faisal**

## **EVALUATION PROCESS**

**All applications have undergone a double-blind peer review process**

## **PARTICIPANT COUNTRIES (12):**

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Republic of Northern Cyprus, Kazakhstan, Algeria, Kosovo, Ghana,  
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## **TOTAL ABSTRACTS: 37**

**The number of abstracts from foreign countries: 22**

**The number of abstracts from Turkey: 15**

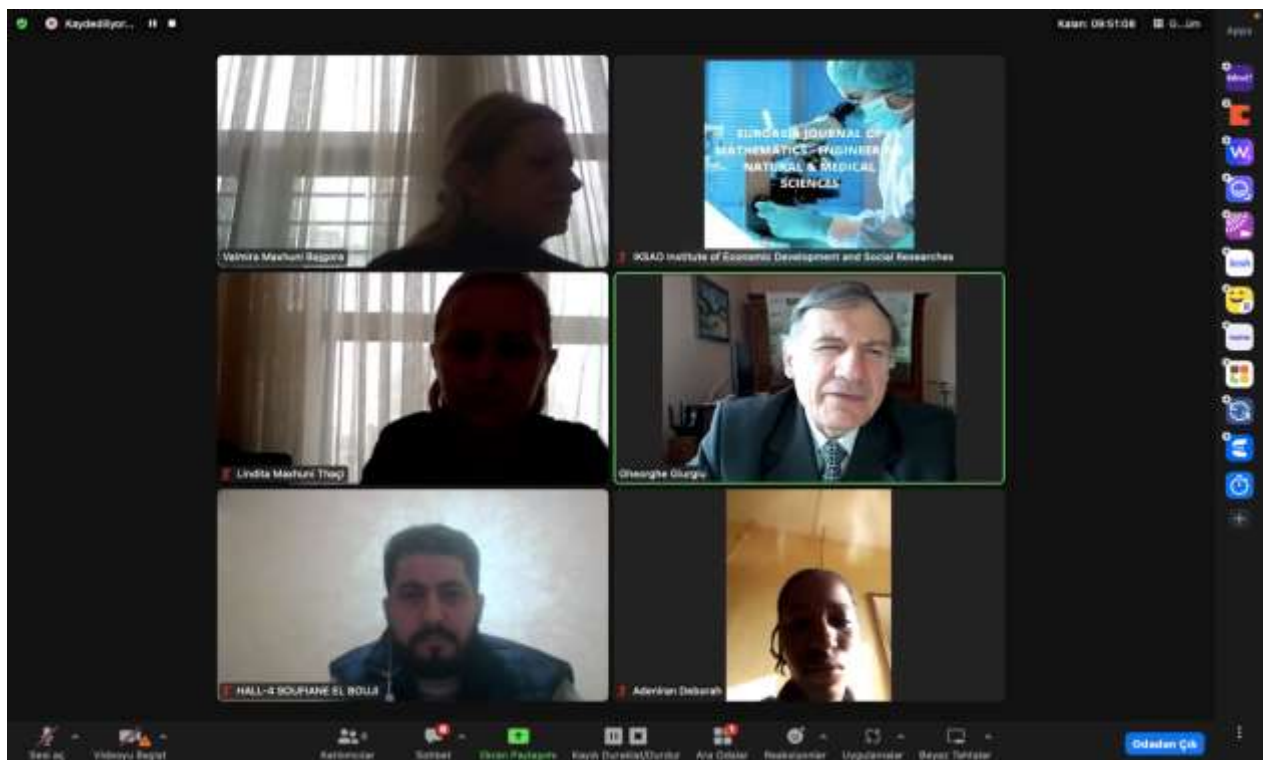
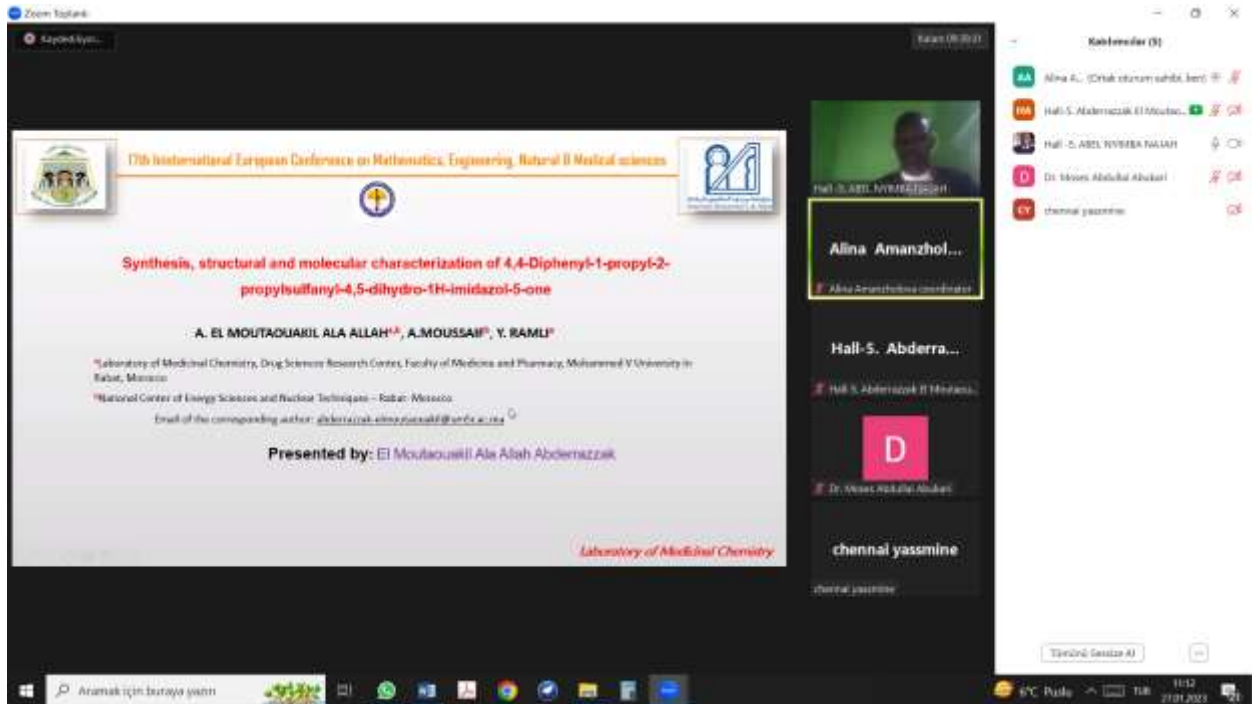
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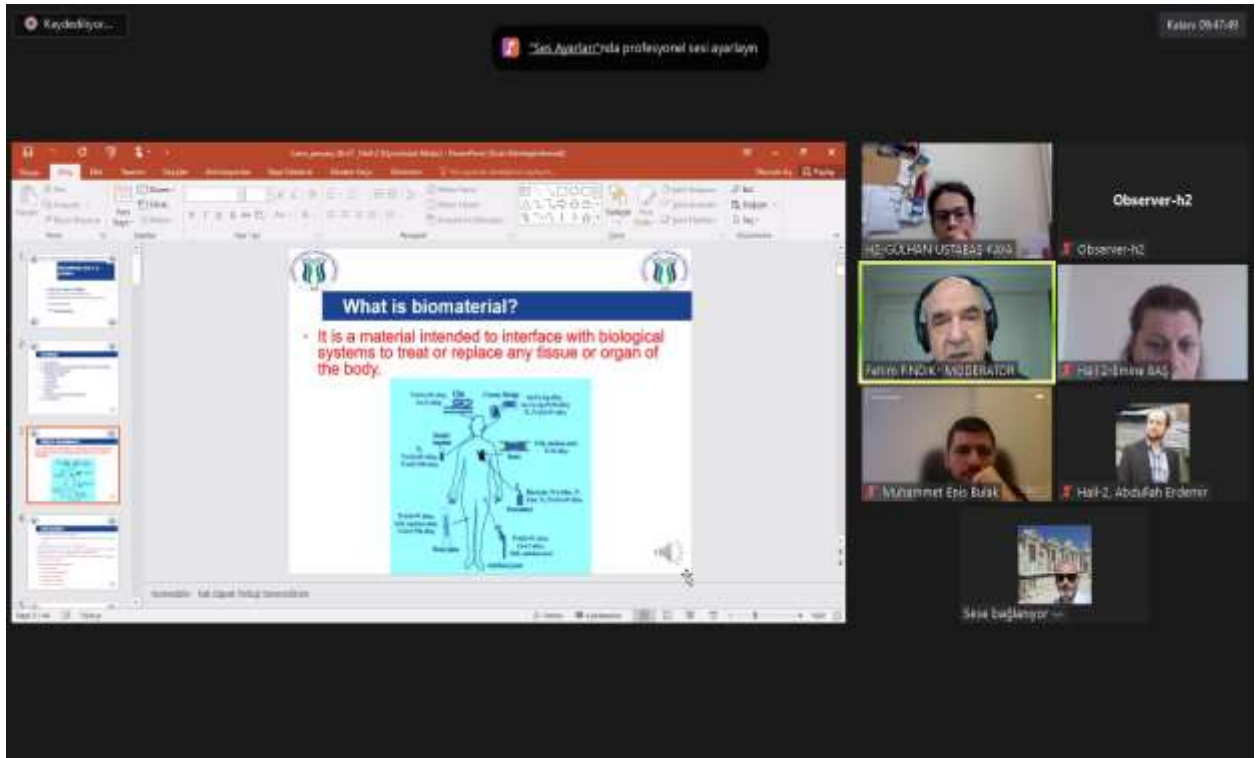
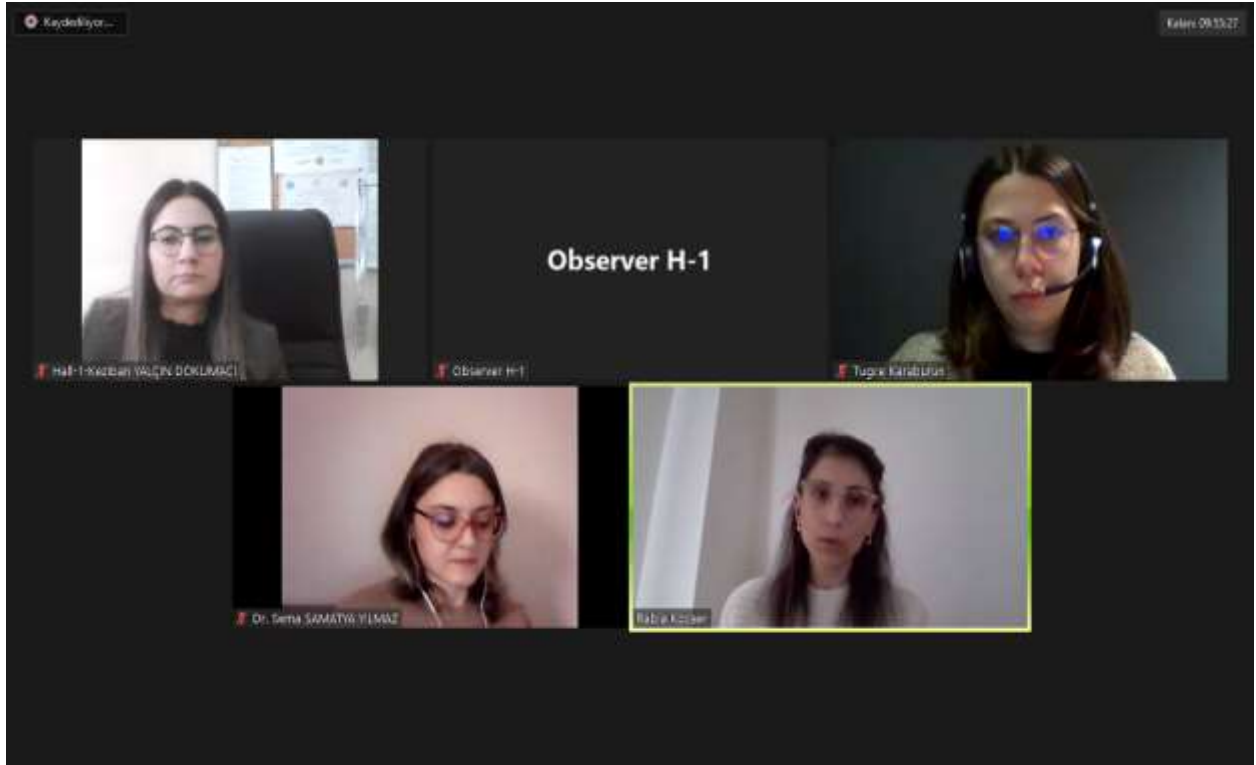
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**MAS 17<sup>th</sup>**  
**INTERNATIONAL EUROPEAN CONFERENCE**  
**ON MATHEMATICS, ENGINEERING, NATURAL**  
**& MEDICAL SCIENCES**

**January 26-27, 2023**  
**Cairo, Egypt**

Conference venue: Cairo, Egypt

**CONFERENCE PROGRAM**

Online (with Video Conference) Presentation



**Meeting ID: 840 5537 1222**

**Passcode: 272727**



## ÖNEMLİ, DİKKATLE OKUYUNUZ LÜTFEN / IMPORTANT, PLEASE READ CAREFULLY

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- ✓ Kongremizde Yazım Kurallarına uygun gönderilmiş ve bilim kurulundan geçen bildirimler için online (video konferans sistemi üzerinden) sunum imkanı sağlanmıştır.
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- ✓ Tüm kongre katılımcıları canlı bağlanarak tüm oturumları dinleyebilir.
- ✓ Moderatör – oturumdaki sunum ve bilimsel tartışma (soru-cevap) kısmından sorumludur.

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- ✓ Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

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### **PARTICIPANT COUNTRIES (12):**

Azerbaijan, Türkiye, Nigeria, Morocco, Pakistan, India, Turkish Republic of Northern Cyprus, Kazakhstan, Algeria, Kosovo, Ghana, Romania





## Hall - 1

27.01.2023

**Moderator: Lect. Rabia KOCAER**

**Meeting ID: 840 5537 1222 / Passcode: 272727**

**Cairo Local Time: 10:00 - 12:00**

**Ankara Local Time: 11:00 - 13:00**

Author(s)	Affiliation	Title
Sema SAMATYA YILMAZ Ayşe AYTAÇ	Kocaeli University, Kocaeli, Turkey	ANTIBACTERIAL EFFECT WOUND DRESSING OBTAINED FROM CROSS- LINKED PVA/NACAS/AG NP ELECTROSPUN MATS
Sema SAMATYA YILMAZ Ayşe AYTAÇ	Kocaeli University, Kocaeli, Turkey	USE IN BIOMEDICAL AREAS OF CROSS-LINKED PVA/NACAS/R-GO NANOMATERIALS PRODUCED WITH ELECTROSPINNING
Tuğçe KARABURUN Fatma Karaca ALBAYRAK	Marmara University, İstanbul, Türkiye.	IMPLEMENTATION OF SAFETY MANAGEMENT SYSTEM IN UPPER AND LOWER TIER ESTABLISHMENTS ACCORDING TO SEVESO III DIRECTIVE AND SPECIAL AUDIT CASES
Rabia KOCAER Aslıhan KOCAER	Afyon Kocatepe University, Afyonkarahisar, Türkiye. Başkent University, Ankara, Türkiye.	REUSE - INDUSTRIAL BUILDING EXAMPLES: PAŞALIMANI FLOUR FACTORY & KASIMPAŞA FLOUR FACTORY
Keziban Yalçın Dokumacı, Haydar Haciseferoğulları	Selcuk University, Konya, Turkey	EFFECT OF THE HOLES POSITION OF SEED DISCS ON IN-ROW SEED DISTRIBUTION UNIFORMITY FOR PNEUMATIC PRECISION VEGETABLE SEEDERS
Ahmedov Agil İlgarovich	Republic of Azerbaijan, Baku, Baku State University	MAPPING AND PROTECTIVE MEASURES AGAINST EROSION IN THE AZERBAIJAN PART OF THE GREATER CAUCASUS

**All participants must join the conference 15 minutes before the session time.**

**Every presentation should last not longer than 10-12 minutes.**

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## Hall - 2

27.01.2023

**Moderator: Prof. Dr. Fehim FINDIK**

**Meeting ID: 840 5537 1222 / Passcode: 272727**

**Cairo Local Time: 10:00 - 12:00**

**Ankara Local Time: 11:00 - 13:00**

Author(s)	Affiliation	Title
Fehim FINDIK	Sakarya Applied Sciences University, Sakarya, Turkey Sakarya University, Sakarya, Turkey	BIOMATERIALS AND 3-D PRINTERS
Muhammet Enis BULAK	Üsküdar University, İstanbul, Türkiye	REDUCE WASTE BY USING VALUE STREAM MAPPING: A CASE STUDY IN A DEFENCE COMPANY
Dr. Lecturer Emine BAŞ	Konya Technical University, Konya, Turkey	DETAILED PARAMETER ANALYSIS FOR AFRICAN VULTURES OPTIMIZATION ALGORITHM
Dr. Lecturer Emine BAŞ	Konya Technical University, Konya, Turkey	BINARY AFRICAN VULTURES OPTIMIZATION ALGORITHM FOR Z-SHAPED TRANSFER FUNCTIONS
Abdullah ERDEMİR Prof. Dr. Mete KALYONCU	MPG Makine Prodüksiyon Grubu Makine İml. San. ve Tic. A.Ş., Konya, Türkiye Konya Teknik University, Konya, Türkiye	OPTIMAL IMPEDANCE CONTROL OF A 2R PLANAR ROBOT MANIPULATOR
Furkan POKER Gülhan USTABAŞ KAYA	Zonguldak Bülent Ecevit University, Zonguldak, Turkey	INVESTIGATION OF THE EFFECT OF TEMPERATURE ON THE ENERGY PRODUCTION FOR PHOTOVOLTAIC PANELS

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### Hall - 3

27.01.2023

**Moderator: Dr. Kərimova Rəna**

**Meeting ID: 840 5537 1222 / Passcode: 272727**

**Cairo Local Time: 10:00 – 12:00**

**Ankara Local Time: 11:00 – 13:00**

Author(s)	Affiliation	Title
Ezgi SEVILMIS Faruk TURGAY Bahtiyar OZCALDIRAN Oya YIGITTURK Faik VURAL Semih ASIKOVALI Burak DURMAZ	Girne American University Ege University Hatay Mustafa Kemal University	EFFECT OF ANAEROBIC TRAINING ON PARAOXANASE 1 (PON1) ACTIVITY AND ROLE OF PON1-L55M POLYMORPHISM
Dr. Kərimova Rəna Cabbar kızı Ağayeva Asiya Hacı kızı Əzizova Əsmət Nizami kızı Cəfərova Zəmfira İbrahim kızı Ələkbərova Mehriban Qəni kızı Bayramov Adil Allahyar oğlu	Azerbaijan Medical University	THE IMPACT OF THE ENVIRONMENT, HARMFUL SUBSTANCES ON HUMAN PHYSIOLOGY AND PATHOLOGIES CAUSED ON THE ENDOCRINE SYSTEM
Dr. Haqverdiyev Bəxtiyar David oğlu Dr. Kərimova Rəna Cabbar kızı Həsənova Xumar Əliövət kızı	Azerbaijan Medical University	ABDOMINAL DISEASES, ACUTE APPENDICITIS AND ACUTE CHOLECYSTITIS TREATMENT METHODS IN ELDERLY PEOPLE
Tugba ONUR Asiye DEMİREL	Health Sciences University, Türkiye	EVALUATION OF THE KNOWLEDGE LEVELS OF INTENSIVE CARE NURSES ABOUT PRESSURE ULCERS
Lect. Türker SALMAN	Fırat University, Türkiye	EFFECT OF PACKAGING ON THE STABILITY OF DRUGS
Lect. Türker SALMAN	Fırat University, Türkiye	THE IMPORTANCE OF POLYMORPHISM IN THE DRUG DEVELOPMENT PROCESS
Namazova Kamala Hasanov Fuad Muradov Nizami Amrahli Gasim Aslanov Azer Aliyeva Aygun Musayeva Narmina Karimov Geys Abbasova Mahrukh Askerova Gunel	Scientific Center of Surgery named after Academician M. Topchubashov, Azerbaijan MediClub Hospital, Intensive Care Department, Azerbaijan	ASSESSMENT OF ACUTE GASTROINTESTINAL BLEEDING BY DIAGNOSTIC INTEGRAL SCALES IN PATIENTS WITH ISCHEMIC HEART DISEASE
Museyibov F. M Aliyeva S.İ Əzizova Ə.N Cəfarova Q.K Khalilov V.H.	Azerbaijan Medical University	EVALUATION OF TWIST, E-Cadherin AND Integrin-β-1 EXPRESSION IN ORTHOKERATINIZED ODONTOGENIC KERATOCYST AND KERATOCYSTIC ODONTOGENIC TUMORS

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**Hall - 4**

**27.01.2023**

**Moderator: Major Gheorghe GIURGIU**

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**Cairo Local Time: 10:00 – 12:00**

**Ankara Local Time: 11:00 – 13:00**

<b>Author(s)</b>	<b>Affiliation</b>	<b>Title</b>
Valmira Maxhuni Bajgora Lindita Maxhuni Thaçi Valë Hysenaj Hoxha Edon Behluli	University of Prishtina, Kosovo	DENTAL CARIES AND FREQUENCY OF DENTAL VISITS
Lindita Maxhuni-Thaçi Valmira Maxhuni-Bajgora Tahire Maloku –Gjergji Burbuqe Nushi-Latifi Lendita Mehmeti Cakuli	University of Prishtina - Faculty of Medicine National Institute of Public Health of Kosovo	SALT INTAKE BY CITIZENS OF KOSOVO CHALLENGE FOR PUBLIC HEALTH
Yusuf Muhammad Sanyinna Daniel Dan-Inna Attah Victoria Ebere Ukatu	Nigerian Army University Biu, Nigeria. Kebbi State University of Science and Technology, Kebbi State, Nigeria	PREVALENCE AND ASSOCIATED RISK FACTORS OF STRONGYLOIDIASIS AMONG ORPHANAGES AND SOME ALMAJIRI SCHOOLS IN SOKOTO METROPOLIS, SOKOTO STATE, NORTH-WESTERN NIGERIA
Khaoula Mkhayar Souad Elkhatabi Samir Chtita	Sidi Mohamed Ben Abdellah-Fez University, Fez, Morocco.Mohammed V University, Rabat, Morocco	DESIGN NOVEL POTENTIAL EGFR INHIBITORS USING 2D QSAR, ADMET PREDICTION, OSIRIS, MOLINSPIRATION, MOLECULAR DOCKING AND MOLECULAR DYNAMIC SIMULATION
G.P. Ashwinkumar C. Sulochana N.Sandeep	Vijayanagara Sri Krishnadevaraya University, Gulbarga University, India. Central University of Karnataka, India	JOULE HEATING EFFECT ON CONTINUOUSLY MOVING THIN NEEDLE IN MHD SAKIADIS FLOW WITH THERMOPHORESIS AND BROWNIAN MOMENT
Kanibaykyzy Kundyzy	Korkyt Ata Kyzylorda University, Kazakhstan	EFFECTIVENESS OF USING THE GRAPHICAL CAPABILITIES OF THE MATLAB COMPUTER PROGRAM IN TEACHING MATHEMATICS
Bendali Nadir Soltani Amir	University of Khemis Miliana, Road of Theniet El Had, Khemis Miliana, 44225, Algeria	DESIGN AND CONTROL OF A 3 DOF ROBOTIC ARM USING SOLIDWORKS AND ARDUINO-UNO
Olawepo, Gabriel Kehinde Adeniran, Deborah Adeola	Department of Plant Biology, University of Ilorin, Nigeria	BIOGENIC SYNTHESIS OF SILVER NANOPARTICLES USING LEAF EXTRACTS OF CHROMOLAENA ODORATA, TITHONIA DIVERSIFOLIA, AND SOLENOSTEMON MONOSTACHYUS
Soufiane El Bouji Noureddine Kamil Zitouni Beidouri	Hassan II University of Casablanca, Casablanca, Morocco	MATHEMATICAL MODELLING OF THE EFFECTIVENESS OF AN OSCILLATING WATER COLUMN WAVE ENERGY CONVERTER (OWC)
Major Gheorghe GIURGIU Prof. dr. Manole COJOCARU	Deniplant-Aide Sante Medical Center, Bucharest, Romania Titu Maiorescu University, Bucharest, Romania	MICROBIOTA MODULATION AS THERAPEUTIC APPROACH IN THE NEUROPATHIC PAIN IN DOG WITH SPINAL CORD INJURY: IMPACT OF POLENOPLASMIN

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## Hall - 5

27.01.2023

**Moderator: Dr. Muhammad Ahmad**

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**Cairo Local Time: 10:00 – 12:00**

**Ankara Local Time: 11:00 – 13:00**

Author(s)	Affiliation	Title
Dr. Nadeem Bhatti Dr. Faiz Muhammad Shaikh Prof. Emeritus	Lead University Lahore SZABAC-Dokri-Sindh- Pakistan IBA-University of Sindh Jamshoro	IMPACT OF POST COVID-19 AFFECTS ON WOMEN VIOLENCE IN PAKISTAN: A CASE STUDY OF DADU SINDH- PAKISTAN
Dr. Mahmood Ahmed	University of Education, Lahore-Pakistan	ANTIUREASE EFFECT OF BENZENESULFONOHYDRAZIDES, IN VITRO AND IN SILICO STUDIES
Abderrazzak EL MOUTAOUAKIL ALA ALLAH Mohcine MISSIOUI Issam AMEZIANE EL HASSANI Hamza ASSILA Mohamed MAATALLAH Khalid KARROUCHI Ahmed MOUSSAIF Youssef RAMLI	Mohammed V University, Rabat, Morocco Cadi Ayyad University, Marrakech, Morocco National Center of Energy Sciences and Nuclear Techniques, Morocco	SYNTHESIS, STRUCTURAL AND MOLECULAR CHARACTERIZATION OF 4,4-Diphenyl-1-propyl-2-propylsulfanyl- 4,5-dihydro-1H-imidazol-5-one
Dr. Muhammad Ahmad	University of Education, Lahore, Pakistan	OPTIMIZING THE SELECTIVITY AND CURRENT EFFICIENCY THROUGH COATED ION-EXCHANGE MEMBRANES
Moses Abdullai ABUKARI Abel Nyimba NAJAH Jonathan Ayelsoma SAMARI	C. K. Tadam University of Technology and Applied Sciences, Ghana St. Charles Minor Seminary/Senior High School, Ghana	IMPROVING TEACHING AND LEARNING OF SENIOR HIGH SCHOOL ORGANIC CHEMISTRY THROUGH COLLABORATIVE APPROACHES
Chennai Yasmine Belaidi Salah	LMCE Laboratory, University of Biskra, BP 145 Biskra 07000, Algeria	IN SILICO INVESTIGATION OF SEVERAL SERIES OF HETEROCYCLIC MOLECULES FOR DRUG DISCOVERY
Hiba Shahid Prof. Dr. Syed Ali Raza Naqvi	Government College University Faisalabad, Pakistan.	ANTIOXIDANT, ENZYME INHIBITION AND TOXICOLOGY STUDIES OF METHANOL EXTRACTS OF SELECTED MEDICINAL PLANTS
Abdurrahman, U. D Hafsat, A. L Kamaluddeen, A Garba, U. A Libata, A. H U. M. Doma	Adamu Augie College of Education, Argungu, Kebbi State, Nigeria. College of Basic and Advanced Studies, Yelwa, Yauri, Kebbi State, Nigeria	STATUS OF THE CONTAMINATION LEVEL OF GASTROINTESTINAL NEMATODE PARASITES IN SMALL RUMINANTS OBTAINED IN YAURI EMIRATE, KEBBI STATE, NIGERIA

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**YENİDEN İŞLEVLENDİRME - ENDÜSTRİ YAPI ÖRNEKLERİ: PAŞA LİMANI UN  
FABRİKASI& KASIMPAŞA UN FABRİKASI**  
**REUSE - INDUSTRIAL BUILDING EXAMPLES: PAŞALIMANI FLOUR FACTORY &  
KASIMPAŞA FLOUR FACTORY**

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## **ÖZET**

Yeniden işlevlendirme süreklilik esas alınarak tarihi değerler korunarak, kullanıcıların koruma dengesinde ihtiyaçlarına cevap verecek düzeyde öneriler sunmayı amaçlamaktadır. Özellikle bu işlevlendirme işleminde mekânsal tasarım, aydınlatma, akustik, ek tasarı önerileri ve kentsel bağlam göz önünde bulundurulmalıdır. Mevcut yapıyı bozmadan yapıların işlevi iyi analiz edilmelidir. Son yıllarda tarihi yapıların yeniden işlevlendirme önerilerinde, yapılarda yeni işlevin ne ve nasıl olacağı, kent ve toplum alanının yeni tasarım projelerinde dikkate alınma noktası, akustik ve aydınlatma projelerinin bu aşamada ne gibi katkı sağlayacağı değerlendirilmektedir. Bu bağlamda, Kent-Bellek ve İnsan-Bellek konuları ele alınmıştır. Az bilinen, unutulmaya yüz tutmuş tarihi yapıların insan belleğinde canlandırılması ya da yapının bilinirliği artırmak için gündelik hayata aktarılması oldukça önemlidir. Bu aşamada modernizimin yan ürünlerinden olan müzeler, 18. yüzyılın sonlarından bu yana toplumun entelektüel ajanları olarak hareket etmektedir. Türkiye’de -disiplin olarak müzecilik- ve -bina tipi olarak müze- gelişimi, Avrupa’dan daha farklı bir yol izleyerek ilerlemiştir. İşlev terimi özellikle 1960’lardan itibaren mimari teori ve eleştirinin odak noktası olmuştur. Paşa Limanı un fabrikası ve Kasımpaşa un fabrikası mevcut durumda insanların ihtiyaçlarını karşılayamamaktadır. Bu amaçla belleği koruyarak bu mekanlara yeniden işlevlendirme aşamasında neler yapılacağı ve insanların kullanımına nasıl açılacağı hakkında öneriler sunulmuştur.

**Anahtar kelimeler:** İşlevlendirme, İşlev, Kasımpaşa, Paşa limanı, Un fabrikası.

## **ABSTRACT**

Re-functioning aims to offer suggestions at a level that will meet the needs of the users in the balance of protection, on the basis of continuity and preserving historical values. Especially in this functionalization process, spatial design, lighting, acoustics, additional design suggestions and urban context should be considered. The function of the structures should be well analyzed without disturbing the existing structure. In recent years, in the proposals for the re-functioning of historical buildings, what and how the new function will be in the buildings, the point of consideration in the new design projects of the city and society area, how the acoustic and lighting projects will contribute at this stage are evaluated. In this context, the subjects of City-Memory and Human-Memory are discussed. It is very important to revive little-known and forgotten historical buildings in human memory or to transfer the building to daily life in order to increase awareness. It is important to protect historical buildings and to transfer them to future generations in social, cultural and architectural context. The buildings, which have been exposed to many functions throughout history, are damaged due to environmental conditions with the change in living standards and requirements. Re-functioning in order to prevent the occurrence of these damages is one of the methods of preserving the structures. In this context, protecting cultural

values and presenting these values to the use of urban life is also important in terms of historical sustainability. At this stage, museums, which are by-products of modernism, have been acting as intellectual agents of society since the end of the 18th century. The development of -museum as a discipline- and -museum as a building type- progressed in Turkey by following a different path than in Europe. The term function has been the focus of architectural theory and criticism, especially since the 1960s. Pasalimanı flour factory and Kasımpaşa flour factory cannot meet the needs of people in the current situation. For this purpose, suggestions were made about what to do during the re-functioning stage and how to open them to people's use, while preserving the memory. In this context, the evaluation of the current situation of the Pasalimanı flour factory, which was re-functionalized, and its suitability to the concept of memory for urban life were discussed. The adaptability of these approaches for Kasımpaşa flour factory has been examined and different usage suggestions have been developed and examined within the scope of protection.

**Keywords:** Functioning, Function, Kasımpaşa, Paşalimanı, Flour factory.

## **Giriş**

Gelecek kuşaklara aktarmak amacıyla tarihi yapıların kültürel, sosyal ve mimari yönden korunması oldukça önemlidir. Geçmişten günümüze köprü vazifesi gören bu yapılar orada bulunan topluluklar hakkında her daim bilgi vermektedir. Yaşayan kültür olarak adlandırabileceğimiz bu yapılarda kültür önemli bir faktör olarak karşımıza çıkmaktadır. Dolayısıyla, kültür, toplumu kuşatan onların yaşama yansıyan tüm özelliklerini yansıtan bir hayat biçimidir. Kültür aktarımını sadece dil ile değil, çeşitli somut eserler ile de yapabilmekteyiz. Özellikle mimari yapıların işlenişi, üslubu ve işlevi orada yaşamış ya da yaşayan toplum hakkında bize bilgi vermektedir. Bunlar bize sunulmuş bir nevi belge niteliğinde alanlardır. Her toplumun medeniyete katkı sağlama açısından kültürel değerleri ve teknik buluşları vardır (Göçer, s. 53). Özellikle konusunu tarihten, sosyal yaşamdan, eserlerden alan birçok kültürel değerler bulunmaktadır. Kültür varlıkları, bir toplumun kültürel alt yapısına ait somut olan tarihi binalar, dans, sözlü tarih unsurlarından meydana gelmektedir (Uğur ve Baykan, 2007: s.5; Gülcan, s.2010: 101; Limon, 2012: 108). Kültür varlıklarına yönelik en yaygın ifadelerden biri de “geçmişin günümüze kullanımı” şeklindedir (Timothy ve Boyd, 2006: s.2). Dolayısıyla kültürün kaynağını geçmiş dönemlere ait eserlerden ve kadim geleneklerden aldığı söylenebilir (Gülcan, 2010: s.100; Chhabra, 2010: s.251).

Geçmiş dönemde ortaya konmuş tarihi yapılar insanların çeşitli ihtiyaçlarına karşılık vermek üzere tasarlanmıştır. Fakat zamanla gerek yaşam standartlarından gerekse ihtiyaçların dönemsel olarak değişmesinden dolayı zarar görmüştür. Bu zararların önüne geçebilmek amacıyla tarihi yapıları koruma noktasında başvurulan yöntemlerden birisi de yeniden işlevlendirme alanıdır. Bu alan, tarihi yapının korunması, kültürel açıdan sahip çıkılması, kent yaşamına ve kullanımına katılması ve tarihsel açıdan devamlılığının sağlanması açısından önemli bir adımdır. Kullanım dışı kalmış yapılara bu sayede yeni kullanım olanakları sağlanmaktadır. Korumada noktasında yeniden işlevlendirme kapsamında çalışılan yapının mimari özellikleri, kültürel değerleri ve çevresel faktörler dikkate alınması gereken başlıca noktalardır.

Yeniden işlevlendirme yapılan tarihi yapılarda kent belleğinin yeniden aktif hale gelmesi amaçlanmaktadır. Tarihi, kültür ve mimari açıdan önemli değerlere sahip bu yapılar kente gerek ekonomik gerekse kültürel açıdan yarar sağlamaktadır. Bu bağlamda mevcut yapının korunması kaynak verimliliği ve sürdürülebilirlik açısından oldukça önemlidir.

Günümüzde “adaptive reuse” olarak ifade edilen, eski bir yapının inşa edilme amacından farklı bir amaç için kullanılması kapsamında yapılan birçok uygulamalar bulunmaktadır. Bu sayede yapının devamlılığı sağlanmakta ve dönüşümü ile kente ve kent sakinlerine her alanda faydalı alanlar oluşturmaktadır.

Paşa limanı un fabrikası ve Kasımpaşa un fabrikası yeniden işlevlendirme ile kent yaşamına sunulmuş yapılarıdır. Unutulmaya yüz tutmuş bu yapılar bu sayede yeniden hayata kazandırılmıştır.

## **Yeniden İşlevlendirme**

Bir yapının kültürel miras olarak tanımlanması ve koruma kapsamında ele alınabilmesi için bazı nitelikleri taşıması gerekmektedir. Bu değerler; duygusal (merak, kimlik, süreklilik, simgesel) kültürel

(belgesel tarihi arkeolojik, estetik, simgesel mimari, kentsel, bilimsel) kullanımsal (işlevsel, ekonomik, sosyal ve politik) olgular şeklinde belirlenmiştir.<sup>1</sup>(M.Berbard Feilden ;1982)

Neo Rasyonellere göre, kentin mimarisini tanımlayan ortak yaşama ilişkin her öge (Urban Artifact) kent nesnesidir. Bu nesnelere, bir anıt, bir çeşme, bir heykel olabilir. Bir başka deyiş ile kent tanımına katılan tüm işaretlerdir (Yıldırım, a.g.e., s:33).

En temel anlamıyla, amacı insana barınak sağlamak olan mekân ve yapının var olma nedeni insandır. İnsanlar tarafından kullanılmayan bir yapı, var oluş nedenini yitirmiş demektir. Bu nedendir ki kullanılmayarak terk edilen, kendi haline bırakılan yapılar harabeye dönmektedirler. Yapıldıkları dönemde, var olan ihtiyaçları işlevsel olarak karşılama amacına yönelik oluşturulan mekân ve yapı, zaman içinde değişen kültürel ve sosyo-ekonomik koşulların beraberinde getirdiği farklılaşan toplumsal yaşam ve ihtiyaçlar sonucunda işlevsel olarak eskiyebilir. Fakat çoğu zaman, işlevsel olarak eskiyen yapılar, yapıldıkları dönemin kültürel, mimari, teknik, sosyal, ekonomik vb. özelliklerinin somut birer yansıması olan fiziksel varlıklarını devam ettirirler. Bu şekilde işlevsel olarak eskiyen fakat fiziksel olarak varlıklarını devam ettiren yapıların terkedilerek yok olmaya mahkûm olmadan oldukları manevi değerlerin geleceğe aktarılması için, yeniden işlevlendirilmeleri gerekmektedir. (Kaşlı Bilge:2018)

Kiper' e (2004) göre koruma;

- *Yerel, bölgesel, ulusal, dini vb. bir kimlik yaratma,*
- *Estetik ve sanatsal değerler oluşturma,*
- *Turizm getirisi sağlama,*
- *Kuşaklararası miras aktarma olarak sınıflandırılabilir.*

Tarihi binanın korunmasına katkı sağlayan ve günün koşullarına uygun olarak tasarlanan yeniden işlevlendirme çerçevesinde birçok farklı yaklaşımlar görülmektedir. Kültürel değeri yüksek olan bu yapıların korunması, yeniden işlevlendirilmesi, restorasyon aşaması birçok farklı yöntemle yenilenerek kullanıma açılmaktadır. Bu aşamalar bazen tek başına bazen de aynı anda kullanılmaktadır. Burada yapının biçimine göre hareket edilmektedir.

Özellikle II. Dünya savaşından sonra mimarlık anlayışı değişmiş ve daha modern yapılar inşa etme anlayışı benimsenmeye başlanmıştır. Fakat bu durum kentin ve insanların modern yapılara karşı eleştirilerine maruz kalmıştır. Bu anlayışa zıt yönde hareket ederek geleneksel yapılara ilgi artmaya başlamıştır. Bunun üzerine araştırmacılar artık tarihi binalara yönelmiştir. Yeniden işlevlendirmenin çeşitli müdahaleler ile mimarlık tarihine kazandırılan binalar ile anılmasına ön ayak olunmuştur.

Scarpa'nın mimari anlayışında modernle eskinin dokusunu harmanlayıp, ortaya koyanların aksine yapıların tarihi ve kültürel değerlerini koruyup yeniden kullanıma sunması yatmaktadır. Zamanı aşan eserler ortaya koymakta ve geçmişin canlı renklerini geleceğin sisli gri renginin üstünde tutmaktadır. Mevcut yapılarda eski ve yeniye alışılmışın dışında bir araya getirilerek topluma kazandırmıştır. Yeni ve eski birçok malzeme ile yapılara çeşitli müdahalelerde bulunmuştur. Birçok mimari tasarımda onun bu özellikleri göz önüne konulmaktadır. Bu sebeple yapıların dış ve iç görünümünü bozmadan yeniden işlevlendirme kapsamında gerçekleştirilmesi gerekir. Yangın veya farklı nedenlerden dolayı zarar görmüş yapılar için yeni bir düzenleme yapılmasına izin verilebilir. Çok önemli mimari öğeler, plan ve iç mekân değerlerine sahip olan 1.grup yapılarda ise yeni kullanıma elverişli, serbest iç düzenlemeler uygulanmaktan çok tarihi mekanların anısını sürdüren düzenlemelere gidilmesi doğrudur (Ahunbay, 2011).

Yeniden işlevlendirme yapılarak topluma kazandırılan yapılar kültürün yaşatılması konusunda kente hem ekonomik anlamda hem de sosyo-kültürel anlamda büyük katkı sağlar. Kentte yaşayan toplumun bilincinin gelişmesiyle tarihi yapıların kullanım alanında değeri artmakta ve yeniden kullanıma açılan yapıların sayesinde ülke ekonomisine önemli katkı sağlanmaktadır.

<sup>1</sup> M.Berbard Feilden, Conservation of Historic Buildings. Technical Studies in the Arts, Archaeology and Architecture, Butter worth Scientific, London , 1982, ss.17-21)

## ARAŞTIRMA

### Yeniden işlevlendirmede Türkiye Örnekleri

Türkiye’de yer alan yeniden işlevlendirme üzerinde çalışılan bazı yapılar aşağıda yer alan tablo’te gösterilmiştir.

**Tablo 1:** Türkiye de yer alan örnek endüstri yapıları

KİMLİK			İŞLEVSEL DURUM		KONUMSAL DURUM		
Fabrikanın adı	Kuruluş Yılı	Kullanım dışı kaldığı tarih	Orijinal İşlevi	Yeniden İşlevi	Konumu ve Çevresi	Tarihinde Konumsal Durum	Günümüzde Konumsal Durum
Dolmabahçe Gazhanesi	1854	1993	Dolmabahçe Sarayı'nın aydınlatılması için Havagazı üretimi	Henüz yeniden işlevlendirme yok	Beşiktaş Maçka Parkı	Hizmet Edeceği yere göre konumlanmıştır	Rekreasyon alanı içinde kalmıştır.
Nakkaştepe (Kuzguncuk) Gazhanesi	1864	1940	Beylerbeyi Sarayı'nın aydınlatılması için Havagazı üretimi	Mülkiyeliler Sosyal ve Kültür Merkezi olarak işlevlendirilme çalışmaları bitirilmiştir.	Kuzguncuk Üsküdar	Hizmet Edeceği yere göre konumlanmıştır	Rekreasyon alanı içinde kalmıştır.
Yedikule Gazhanesi	1880	1993	Sur için aydınlatılması için Havagazı üretimi	Şuanda İETT deposu olarak kullanılmaktadır. Çalışmalar mevcuttur. (İBB)	Yedikule /Fatih Marmara denizi kıyısı	Demiryoluna yakın	Rekreasyon alanı içinde kalmıştır.
Hasanpaşa Gazhanesi	1891	1993	Kadıköy Üsküdar ve 8. Daire-i Bolodiyo sınırlarını aydınlatmak ve Anadolu Yakasının gaz ihtiyamını karşılamak için Havagazı ve sugazı üretimi	Avan Proje yapılmıştır (Tanyeli,2008) İBB çalışmalara devam ediyor.	Hasanpaşa /Kubalider /Kadıköy	Hizmet Edeceği yere göre konumlanmıştır	Kentsel alan içinde kalmıştır.
Silahtarağa Elektrik Santrali	1914	1983	Elektrik Üretimi	Yeniden işlevlendirme tamamlanmıştır.Kültür merkezi ve müze olarak kullanılmaktadır.(2008)	Silahtarağa/Kağthane Haliç Kıyısı	Denizyolu ile kömür naklinin uygun olduğu yere konumlanmıştır.	Rekreasyon alanı içinde kalmıştır.
Bağlarbaşı Elektrik Fabrikası ve Tramvay Deposu	20.yy başı	1985	Elektrik Üretimi	Yeniden işlevlendirme tamamlanmıştır.Kültür merkezi ve müze olarak kullanılmaktadır.(2008)	Bağlarbaşı /Üsküdar	Hizmet Edeceği yere göre konumlanmıştır	Günümüzde kentsel alan içinde kalmıştır.

**MAŞ 17th**  
**INTERNATIONAL EUROPEAN CONFERENCE ON MATHEMATICS, ENGINEERING,**  
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<b>Paşalimanı Un Fabrikası</b>	<b>1863</b>	<b>1940</b>	<b>Un Üretimi</b>	<b>Henüz yeniden işlevlendirme çalışmaları yapılmamıştır.</b>	<b>Paşalimanı/Üsküdar</b>	<b>Deniz kenarında olma</b>	<b>Günümüzde kentsel alan içinde kalmıştır.</b>
Askeri Un Fabrikası	1886		Un Üretimi	Otopark olarak kullanılmaktadır.	Unkapanı	Deniz kenarında olma	Günümüzde kentsel alan içinde kalmıştır.
Cibali Tütün ve Sigara Fabrikası	1884	1995	Tütün işlemek, sigara ve puro üretmek	Kadir Has Üniversitesi Eğitim binası ve müze olarak kullanılmaktadır	Cibali /Fatih Haliç kıyısı	Deniz Ulaşımına yakın konumlanmıştır.	Günümüzde kentsel alan içinde haliç kıyısı rekreasyon alanına yakın konumlanmıştır.
<b>Kasımpaşa Un Fabrikası</b>	<b>1886</b>	<b>1982</b>	<b>Un Üretimi</b>	<b>Hanüz işlevlendirme çalışmaları yok</b>	<b>Kasımpaşa</b>	<b>hizmet Edeceği yere göre konumlanmıştır</b>	<b>Günümüzde kentsel alan içinde kalmıştır.</b>
Bomonti Bira Fabrikası	1902	1982	Bira kalıp buz ve gazoz üretimi	Özel bir holding tarafından satın alındı. Otel olarak yapılması planlanmaktadır	Feriköy /Şişli		Günümüzde kentsel alan içinde kalmıştır.
Hamidiye Su Tesisi, Cendere Su Pompa İstasyonu	1902		Kağıthane membasularının dağıtımı için susyun 120 mye yükselmesini sağlamak için kurulmuş su pompa istasyonu	İstanbul Su Medeniyetleri Müzesi olarak faaliyettedir.	Ayazağa cendere Caddesi/ Maslak		Kaynaklara yakın olma
Paşabahçe İspirto ve İçki Fabrikası	1923	Fabrika işlevi sürmektedir.	İspirto ve içki üretimi	İspirto üretimi ve bazı tekel şarapla şişelenmesi	Paşabahçe /Beykoz	Ulaşım nedeniyle deniz kıyısında olma	Günümüzde boğaz kıyısında rekreasyon alanı içindedir.
Likör ve Kanyak Fabrikası	1930	2000	Likör ve kanyak üretimi	arazisi ile birlikte satılmıştır. Henüz proje çalışmaları açıklanmamıştır.	Büyükdere Caddesi/ Mecidiyeköy	Kanyağa yakın Mecidiyeköy de bağlar mevcuttu.	Günümüzde kentsel alan içinde kalmıştır. Ali Sami Yen stadı bitişiğindedir.
Feshane Fabrika-i Hümayunu	1833		Fes Üretimi	Fuar ve Sergi alanı olarak kullanılmaktadır	Defterdar/ Eyüp	Deniz kenarında olma	Günümüzde rekreasyon alanı içindedir.
Bakırköy Bez Fabrikası	1850	Fabrika İşlevini sürdürmektedir.	Bez Üretimi	Tekstil Üretimi	Bakırköy	Demiryoluna yakın	Günümüzde kentsel alana yakın rekreasyon alanı içindedir.

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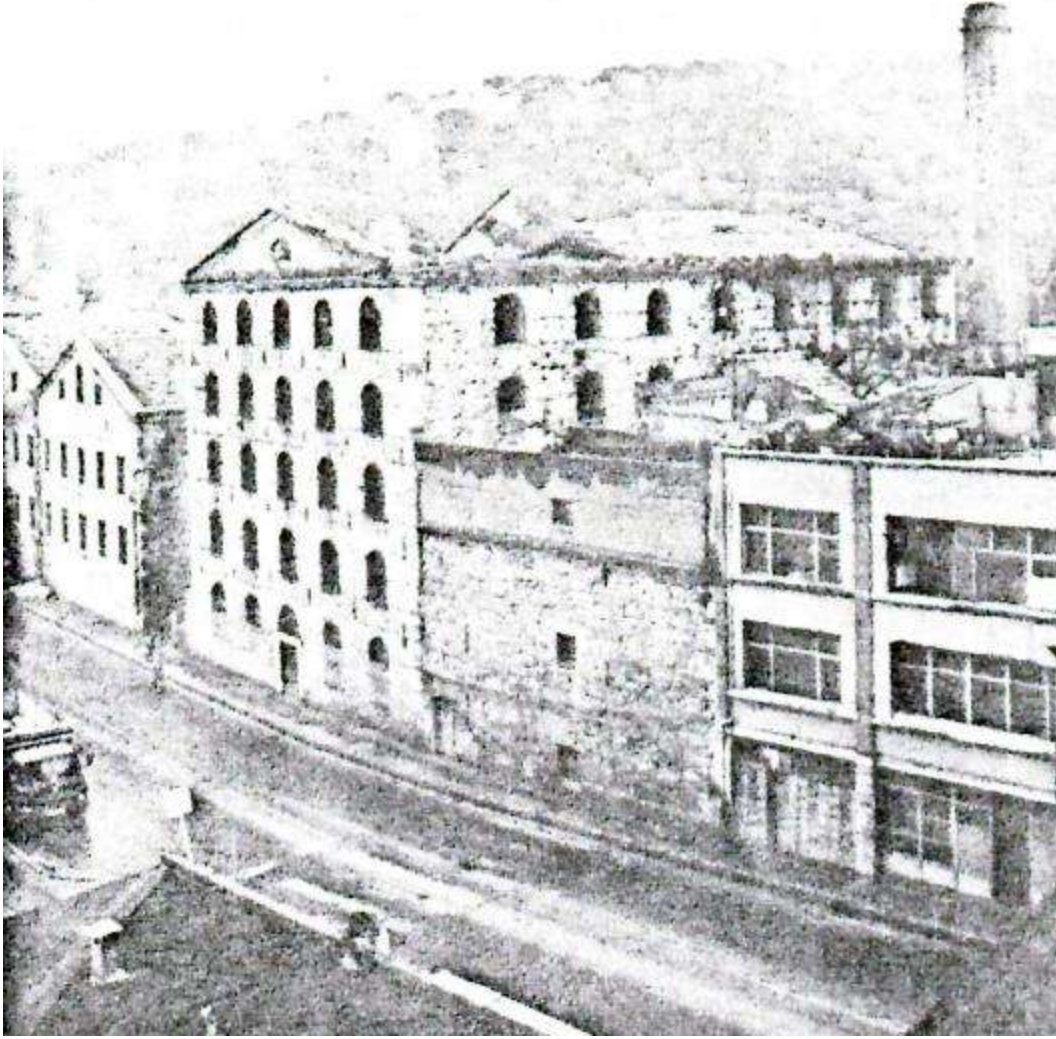
Tophane-i Amire	1730-1740	I. Dünya savaşı sonrası dönem	Top Üretimi	Sergi alanı, kültür ve sanat merkezi	Tophane	Deniz kenarında olma	Günümüzde kentsel alan içinde rekreasyon alanı sınırlıdır.
Lengerhane-i Amire	1703-1730	1951	Lenger(çapa ve zincir)üretimi ve top dökümü	Müze olarak kullanılmaktadır	Hasköy	Deniz kenarında olma	Günümüzde kentsel alan içinde rekreasyon alanı sınırlıdır.
Darphane-i Amire	18.yy sonu		Madeni para basımı, saray için altın gümüş eşya hatıra sikkeleri ve mücevher üretimi	Darphane emniyeti binası ve avlunun kuzeybatı köşesinde yapı İstanbul Rölöve ve Anıtlar Müdürlüğüne, dökümhane binası İstanbul Restorasyon Konservasyon Merkez Laboratuvarı Müdürlüğüne dönüştürülmüştür. Darphane binaları sergi mekanı olarak kullanılmak üzere 1996 da ön değerlendirme ve proje çalışması yapılmış ve uygulanmıştır.	Topkapı Sarayı/ Sultanahmet	Hizmet edeceği yere göre konumlanmıştır.	Şu anda müze olarak kullanılan Topkapı sarayı müzesi içinde gezi alanı içinde yer almaktadır.
Zeytinburnu Makine /Demir Fabrikası	1845	Halen kullanılmaktadır.	Makine Fabrikası demir işleme	Askeri araçların bakım ve onarımı için kullanılmaktadır	Zeytinburnu	Demiryoluna yakın	Günümüzde kentsel alana yakın rekreasyon alanı içindedir.
Şirket-i Hayriye Tersanesi	1861	1996	Gemi onarımı ve küçük gemi yapımı	Rahmi Koç Müzesi olarak kullanılmaktadır	Hasköy	Deniz kenarında olma	Günümüzde kentsel alana yakın rekreasyon alanı içindedir.
Nalbanthane	1841		Nalbanthane	TSK mesiti olarak kullanılmaktadır	Üsküdar		
Haydarpaşa Garı'nın Atölyeleri	20.yy başı	İşlevine devam etmektedir.???	Atölye	Atölye	Kadıköy		
Şahbaz Açıya Mahdumu Tuğla Fabrikası	1882		Tuğla Üretimi	Henüz yeniden işlevlendirme çalışması yapılmamıştır.	Sütlüce	Su kenarında olması	Günümüzde kentsel alan ve rekreasyon alanı sınırlıdır.
Yıldız Çini Fabrika-i Hümayunu	1893-1894		Çini ve Porselen Üretimi	Çini ve Porselen Üretimi	Yıldız /Yıldız Sarayı Bahçesi	Hizmet edeceği yere göre konumlanmıştır.	Günümüzde rekreasyon alanındadır.

Paşabahçe Tuğla ve Kiremit Fabrikası	1910		Tuğla ve kiremit Üretimi	Fabrika alanının ortadan kaldırılıp yerine konut inşa edilmesi görüşülmekte...	Paşabahçe		Günümüzde kentsel alan içinde kalmıştır.
Arslan Osmanlı Anonim Şirketi Çimento Fabrikası	1910		Çimento Üretimi	Çimento Üretimi	Darıca		
Haznedar Tuğl Fabrikası	1918'den önce	Halen kullanılmaktadır.	Tuğla ve kiremit Üretimi	Sanayi tipi ateş tuğlası üretimi	Merter / Bakırköy		
Paşabahçe Şişe ve Cam Fabrikası	1934		Şişe ve Cam Üretimi	Şişe ve Cam Üretimi	Paşabahçe		
Yunus Çimento Fabrikası	1926		Çimento Üretimi	İşlevini yitirmiştir.	Kartal		

Tablo 1:Türkiye'de Yeniden işlevlendirilen Tarihi Yapılar

Kaynak: Kaşlı,Bilge 2019

### Paşalimanı Un Fabrikası



Kaynak: Divan, 1984

“Üsküdar’ dan Kuzguncuk’a giden sahil yolunun sağında yer alan Paşalimanı Un Fabrikası, Abdülmecit zamanında 1858 yılında yapılmıştır.” (Divan, 1984). Fabrikanın yapım tarihi ile ilgili farklı kaynaklarda farklı ifadeler kullanılmıştır.

Yapım tarihinin net olmadığı hakkında bilgi veren kaynakta yer alan ifade: “Değirmenin ilk olarak hangi tarihte yapıldığı hakkında bir bilgiye ulaşamadık, ancak Mayıs 1869 tarihinde bu değirmenden çıkan dumanın çevreyi rahatsız ettiği hususundaki şikâyetler üzerine, buharlı makine ile çalışacak fabrikaların filtre takmaları ve kokkömürü gibi kaliteli yakacak kullanmalarına dair nizamnameye uygunluğunu denetlemek amacıyla Hüseyin Bey isimli bir kişinin görevlendirildiğine dair bir Şura-yı Devlet kararı bulunmaktadır. Muhtemelen bu değirmen zahire ambarlarının inşaatından kısa bir süre sonra yapılmış olmalıdır.” (Genim, 2012).

Divan’ın fabrika ile ilgili çalışma yaptığı dönemde yapının durumunu şu şekilde ifade etmiştir: “Bugün çatılarının çökmüş olması nedeniyle döşemeleri de yer yer yıkılmış ve çürümeye terkedilmiştir. Yapı 1940 yılından beri kullanılmadığından harap bir durumdadır.” (Divan, 1984).

Paşalimanı Un Fabrikası, “Gayrimenkul Eski Eserler Anıtlar Yüksek Kurulu tarafından 14.04.1973 gün ve 7086 sayılı karar I. Derece eski eser olarak tescil edilmiştir.” (Köksal, 2005).





*Resim 1 Mevcut Durum*

*Kaynak: Divan, 1984 Kaynak: Seçil Kona arşivi, 2015*

Yapının belli bir bölümü günümüzde İstanbul devlet opera balesinin prova odaları olarak kullanılmaktadır. Ambar binası ise İstanbul Devlet Tiyatrosu Üsküdar Tekel Sahneleri olarak kullanılmaktadır. Tiyatro gösterilerinin yanı sıra İstanbul Devlet Senfoni Orkestrası ve İstanbul Devlet Türk Halk Müziği Korosu grubu prova çalışmalarını bu yapıda yapmaktadırlar.

### **Kasımpaşa un fabrikası**

Kasımpaşa un fabrikası İstanbul'un Beyoğlu ilçesinde yer almaktadır. Sultan Abdülmecit döneminde değirmen binası olarak inşa edilmiştir. Fabrikası 3 yapı bloğundan oluşmaktadır. Değirmen, depo ve ambar binası. Yapılar oldukça bakımsızdır. Özellikle 20. Yy. Da elektrik enerjisinin yaygınlaşması ile fabrika üretime devam etmiş ve aktif olarak kullanılmıştır.

Yapının büyük kısmı içinde bulunduğu semtin büyük yangınlar görmesine rağmen günümüze kadar ulaşmıştır. Fakat bakım olmadığı için ve uzun yıllardır aktif bir şekilde kullanılmadığı için harap bir durumdadır. Çevresel koşullardan dolayı pencere ve çerçeveler kırıktır. Bazı alanlarda çatı dahi yoktur. Değirmen binası ilk olarak inşa edilmiş olmasına rağmen günümüze kadar büyük kısmı ulaşmıştır. Mimari yönden önemli bir parçası olan bacasının ise belli bir bölümü yoktur. Koruma bölge müdürlüğü tarafından yapının üzerinde çalışmalar yapılacağına karar verilmiş ve kültürel bir tesis olarak yeniden yaşama sunulacağı söylenmektedir. Birçok mimarlık ofisi tarafından çeşitli projeleri hazırlanmış ve uygulamaya geçirilmesi için beklenmektedir.

Restorasyon konusu hem ilçe hem de İstanbul için önemlidir. Bu tarz yapılar genellikle herhangi bir belgelendirme yapılmadan yok olup gitmekte ve kent belleğinde negatif yönde bir etki yaratmaktadır. Kültürel mirasın korunması kapsamında bu yapıların varlığını korumak gerek ekonomik gerekse sosyal açıdan önemlidir. Kültürün taşıyıcılığında somut olarak göze çarpan bu binalar toplumun her döneminden bilgiler vermektedir. Bu sebeple her açıdan daha dikkatli incelenmeli ve yeniden topluma kazandırılmalıdır.

### **Sonuç**

Bu çalışmada endüstriyel yapılarda yeniden işlevlendirme kavramının mimari ve kent bilinci açısından önemi anlatılmaktadır. Bu yapılar gerek mimari gerekse sosyo-kültürel açıdan önemli mekanlardır. Çeşitli proje örnekleri ile öne çıkan bu yapıların değerlendirilmesi ve halka çeşitli amaçlar güdülenerek açılması kent bilinci ve kent belleği için önemli bir basamak olacaktır. Kentin sahip olduğu değerlerin

korunması, geçmişin yaşatılması günümüzde daha da önem kazanmaktadır.

Endüstriyel miras yapı alanlarının kentin mimari kimliğinin yanı sıra tarihsel birçok izi içinde barındırması, kültür bağlamında değerini ortaya koymaktadır. Dolayısıyla birçok noktada önem taşıyan bu endüstriyel yapılar toplumun bellek, yaşam tarzı ve yerel kültürü açısından da çeşitli referansları göz önüne sermektedir.

Yeniden işlevlendirilecek yapıların sahip olduğu değer in bellekteki izleriyle toplumsal önem taşıması geçmişe dair okumaların yapılabileceği birer araştırma alanı olmaktadır. Bu nedenle endüstriye yapıların iyi analiz edilip orada yaşayan yerel kültürü iyi değerlendirmek gerekmektedir.

Bu analizler çerçevesinde endüstriyel yapılar zaman içerisinde değişebilmekte ve farklı işlevlendirme projeleri ile karşımıza çıkabilmektedir. Tarihte bu endüstriyel yapılar birçok yönüyle toplumu etkilemiş, tarihi kimliği yansıtmıştır. Bu sebeple kent belleğini en iyi yansıtan bu yapılar belleğin sürdürülebilir olması bağlamında önemli bir konuma sahiptir.

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## BIOMATERIALS AND 3-D PRINTERS

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### ABSTRACT

A biomaterial is a material used to build or reuse a body's body. The biomaterial can be implanted inside the body, which imposes some positive restrictions on life. First of all, a biomaterial must be biocompatible and not cause an adverse reaction. The field of biomaterials has become exciting as these materials improve the quality of human life. The most important requirement in the selection of biomaterials is that it is acceptable to the human body. The most common grades of biomaterials used are metals, polymers, ceramics and composites. These materials also have advantages and disadvantages compared to each other. Therefore, they are used in different parts of the body for different purposes.

On the other hand, 3D printing (3DP) is an emerging technology for sequential layering with numerous design flexibility. The most extensive applications of 3DP technology are found in the automotive, aerospace, construction, metals and alloys, electronics and biomedical fields. In this study, a brief history of 3DP is introduced, followed by the embedding mechanism of different continuous fibers in different plastics and their microstructural and mechanical properties. Additionally, future research guidelines have been identified based on the limitations of current technology.

**Keywords:** Biomaterials, Implants, Metals, Polymers, Ceramics, Composites, 3-d printers.

### INTRODUCTION

A biomaterial is any artificial material that is utilized to substitute or repair the function of a body tissue and is in continuous or intermittent contact with body fluids [1]. This definition is somewhat preventive as it does not comprise materials used for devices such as surgical or dental instruments.

Though these instruments are exposed to bodily fluids, they do not alter or increase the function of human tissue. In addition, materials used for external prosthetics, such as artificial limbs or devices, are also excepted from the above definition. Because, for example, materials such as hearing aids are not exposed to body fluids.

Exposure to body fluids usually means that the biomaterial is placed inside the body, and this places some strict limitations on the materials that can be utilized as biomaterials [1]. First of all, a biomaterial must be biocompatible - it should not receive a negative reaction from the body and vice versa.

Furthermore, it should be non-toxic and non-carcinogenic. These requirements eliminate many existing engineering materials. Next, the biomaterial must have sufficient mechanical and physical properties to serve as a reinforcement or replacement of body tissues. In addition, the biomaterial must be suitable for forming or processing, relatively low cost, and readily available. The ideal biomaterial should be biocompatible, resistant to degradation, adequate strength, low elastic modulus and also resistant to abrasion.

One of the main reasons for using biomaterials is to physically replace damaged or destroyed hard or soft tissues by some pathological process [2]. The tissues and structures of the body often work without problems for a long time. However, people can suffer from various destructive processes such as fractures, infections and cancer that sometimes cause pain, disfigurement or loss of function. In such cases, it is necessary to remove the diseased tissue and replace it with some appropriate artificial

material.

One of the most prominent application areas of biomaterials is orthopedic implant devices. Both osteoarthritis and rheumatoid arthritis affect the structure of freely movable (synovial) joints such as the shoulder, knee, hip, elbow and ankle (Figure 1). Pain in such joints can be significant, especially weight-bearing joints such as the hip and knee, and the effects on ambulatory function can be quite devastating. Since the advent of anesthesia it has been conceivable to substitute these joints with prostheses, the relief of pain and restoration of mobility is well known to thousands of patients. Various metals, polymers and ceramics are used for orthopedic applications.

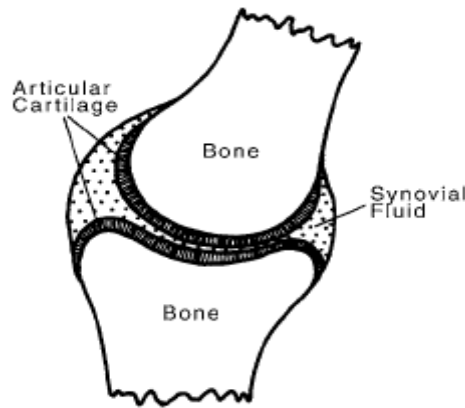


Figure 1. Key components of a natural synovial joint. The synovial fluid acts as a lubricant. In an artificial joint, lubrication is supplied by low-friction polymeric bearing materials [3].

Biomaterials can also be used in cardiovascular applications, eye surgery such as cataracts, drug delivery systems, wound healing and dental applications for healing cancerous tissues.

In this study, firstly, the desired properties of biomaterials were reviewed and characterization methods were mentioned. Then, various metallic, ceramic, polymeric and composite materials used as biomaterials are briefly discussed. After specifying the advantages and disadvantages of these materials, a perspective on which materials may be needed more in the future is presented.

### **REQUIREMENTS AND CHARACTERIZATION OF BIOMATERIALS**

The performance and success of every implant and medical device used to perform certain functions in the human body depends on the properties and biocompatibility of the biomaterials selected for their structures. Herein lies the importance of establishing a process that allows for a complete characterization of the biomaterial and an understanding of the biological responses elicited when implanted in a living system. Many methods from the medical and engineering disciplines are used to characterize biomaterials, which provide essential information that allows the device to be determined for its intended biomedical function and whether it meets regulatory standards.

The different properties of biomaterials have been exposed to have an important impact on their dynamic interactions with the biological environment when used as medical implants and organ or tissue replacements. The performance and success of each of these implants depends on the properties and biocompatibility of the biomaterial used to create it. Therefore, when designing any medical device or implant, it is crucial to evaluate material properties in the context of future biomedical applications.

In general, the most important properties associated with biomaterials are classified as chemical, physical, mechanical and biological according to the volume and surface of the material. These are summarized in Figure 2 and explained in detail below.

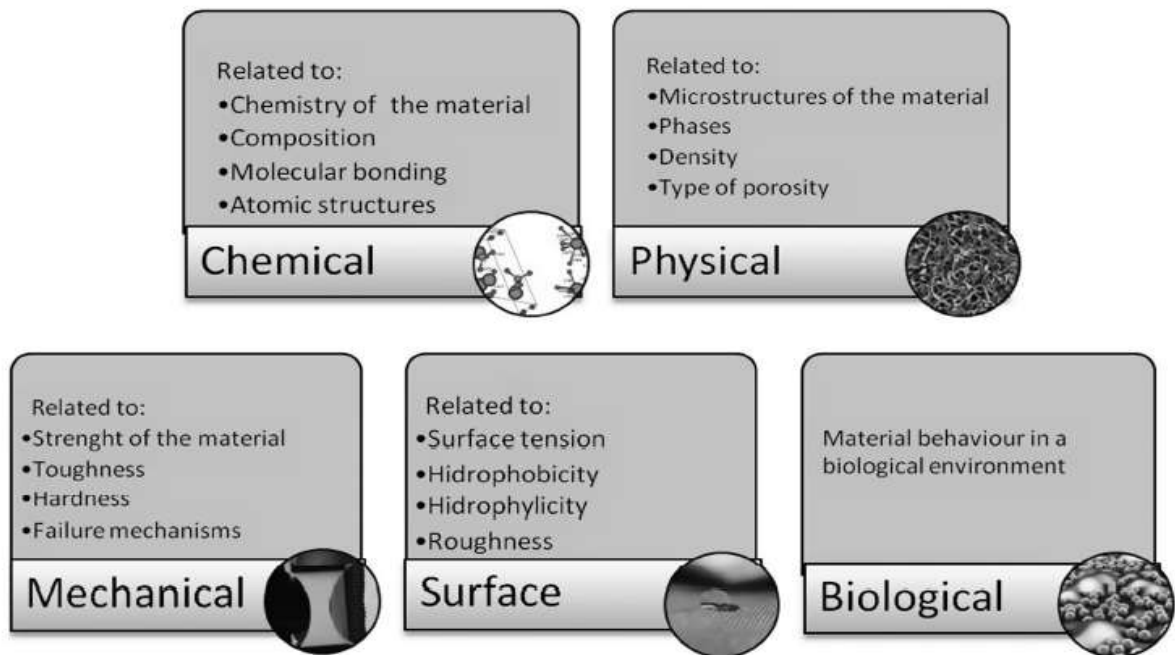


Figure 2. Scheme of biomaterials properties.

Different material systems have general advantageous properties that make them more suitable for particular applications. For example, metallic materials are widely known for their high ductility, strength and toughness; Their excellent mechanical properties added to their good corrosion resistance make them an ideal material for bone and joint replacement and bone fracture fixation. Ceramic materials stand out with their hardness and low wear rates; Although they are not as resistant to fracture as metals, they have the highest compressive strength, so ceramics are widely used in load-bearing implants. In addition, ceramics are resistant to microbial attack and are widely used in bone tissue engineering.

Polymers may not be as strong as metals and ceramics, but they are extensively utilized materials in healthcare because of their versatility and other valuable properties. Polymeric materials can be flexible or rigid, biodegradable or biologically inert, strong or brittle, chemically resistant, etc., depending on their intended function. It could be. Its multiple uses range from sutures, blood vessels and soft tissues to facial and orthopedic prostheses. Composite materials, on the other hand, have numerous properties depending on their components and individual properties. Generally, composites are designed to combine the best of two different materials or to improve the properties of one of them. For example, bioactive glasses have poor mechanical strength and incompatibility with bone, limiting their application in load-bearing applications; however, these materials combine with polymers to form composites with improved mechanical properties and biocompatibility that can be used in bone repair [4]. Other applications of the composites have been found in dental resins and bone cement.

Biomaterials are used in the construction of biomedical devices to perform many specific functions in the human body; Selecting the most suitable material for these functions is a complex process dependent on specific mechanical, chemical, structural and biological requirements. During this process, it is essential to characterize the material to reveal its properties and verify whether these requirements are met. Many disciplines are involved in the characterization of biomaterials; physical and engineering sciences focus on physical, mechanical and surface properties, while biological sciences and medicine focus on biological properties and biocompatibility. The integration of different techniques based on these sciences allows researchers to comprehensively analyze the properties of biomaterials and determine their suitability for the intended biomedical application. A schematic outline of the biomaterial characterization is revealed in Figure 3; the first level of testing is achieved when the physical, chemical, mechanical and surface properties of the material are determined; however, after the second level of testing, which includes biological in-vitro and in-vivo studies, devices can be considered for production.

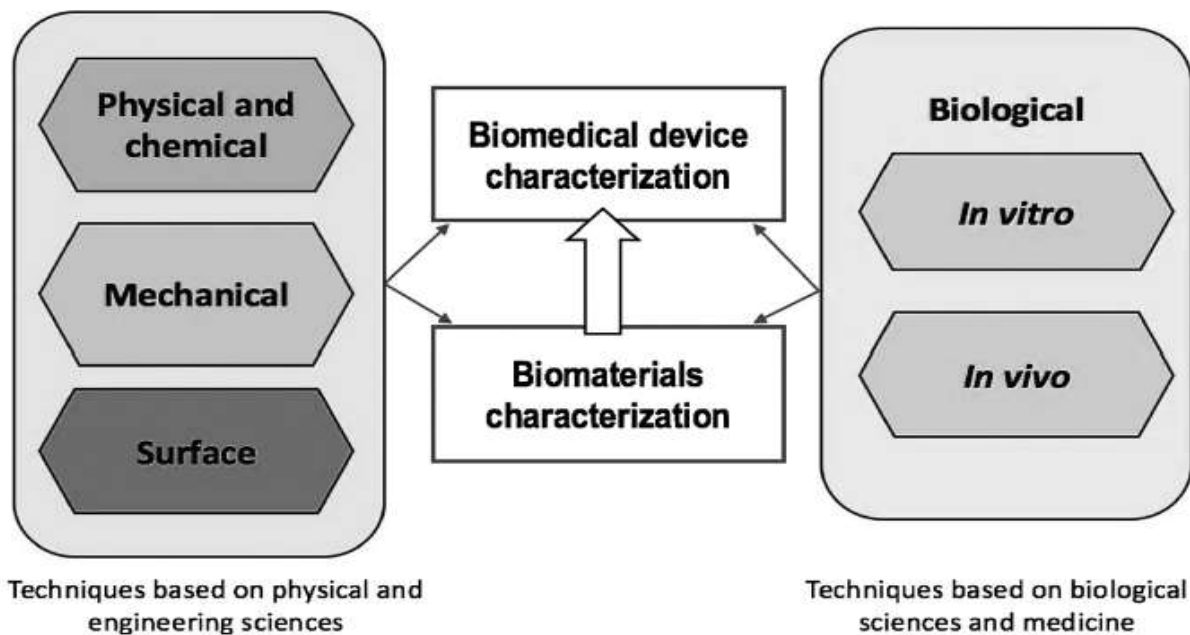


Figure 3. Schematic outline of biomaterials characterization

## METALLIC BIOMATERIALS

Metals are used as biomaterials due to their excellent mechanical properties and thermal and electrical conductivity. Since some electrons are free in metals, they can transfer thermal energy and electrical charge quickly. Since the metallic bond is non-directional, metals can easily undergo plastic deformation.

Some metals are used in many fields because of their excellent corrosion resistance and mechanical properties. For example, passive replacements for fracture healing, dental implants, screws for knee and hip joint replacement, spine fixation devices. In addition, some metallic alloys are also used for active roles such as orthodontic arch wires, vascular stents, catheter guide wires.

### Stainless steel

The first stainless steel used for implant manufacture was 18-8 (type 302). Later, 18-8sMo stainless steel was introduced. This alloy is known as type 316 stainless steel. In order to provide corrosion resistance in stainless steels, at least 11% chromium must be added to the steel.

Austenitic stainless steels (316 and 316L) are most commonly used for implant fabrication. These steels can only be hardened by cold working. This group of stainless steels has better corrosion resistance than others and is non-magnetic. The addition of molybdenum increases resistance to pitting corrosion in salt water. In the literature (ASTM), type 316L is recommended instead of 316 for implant production.

Nickel stabilizes the austenitic phase [γ, face-centered cubic crystal (fcc) structure] at room temperature and increases corrosion resistance. Austenitic phase formation can be affected by both Ni and Cr contents, as shown in Figure 4 for 0.10% carbon stainless steels. The minimum amount of Ni to sustain the austenitic phase is about 10%.

Even 316L stainless steel can corrode the bone fracture plate inside the stem under certain conditions in a highly stressed and oxygen-free area, such as the contacts under the screws of the stem. Therefore, these stainless steels are only suitable for use in temporary implant devices such as broken plates, screws, and hip nails [5].

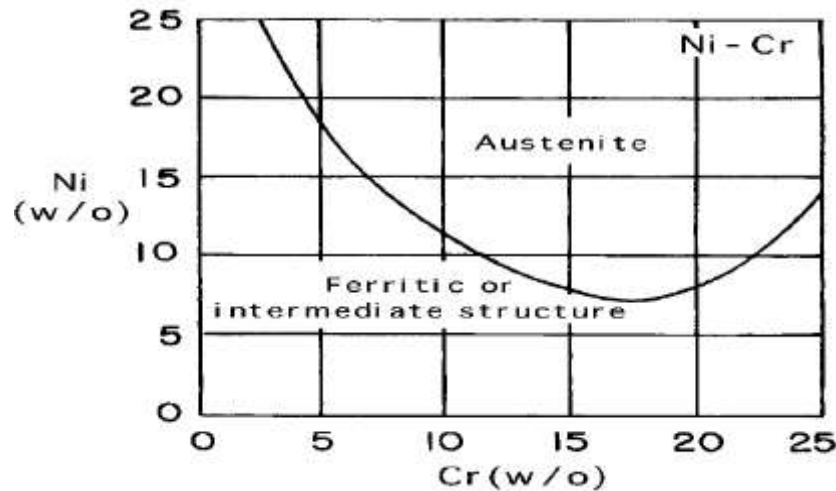


Fig 4 The effect of Ni and Cr contents on the austenitic phase of stainless steels have 0.1% C

### Co-alloys

Two types of cobalt-chromium alloys can be produced: (1) castable CoCrMo alloy and (2) forged, usually by (hot) forging. Castable CoCrMo alloy has been utilized in dentistry for decades and relatively recently in artificial joint construction. Forged CoNiCrMo alloy is relatively new and is now used in the construction of prosthetic bodies such as knees and hips.

ASTM mentions four kinds of CoCr alloys suggested for surgical implant applications: (1) cast CoCrMo alloy (F75), (2) wrought CoCrWNi alloy (F90), (3) wrought CoNiCrMo alloy (F562), and (4) wrought CoNiCrMoWFe alloy (F563). The compositions of each alloy are summarized in Table 1. Currently, only two of the four alloys, the castable CoCrMo and the forged CoNiCrMo alloy, are widely used in implant manufacturing. As Table 1 shows, the compositions are fairly diverse from each other.

The two plain rudiments of CoCr alloys form a solid solution with up to 65% Co. Molybdenum is supplemented to obtain finer grains resulting in higher strength after casting or forging. It increases the solid solution strengthening and corrosion resistance of the chromium alloy.

CoNiCrMo alloy contains about 35% Co and Ni. The alloy is corrosion resistant to seawater under stress. Cold working can significantly increase the strength of the alloy. However, only hot forging can be used, especially when making large devices such as hip joint bodies.

Table 1 Chemical Compositions of CoCr Alloys [6]

Element	CoCrMo (F75)		CoCrWNi (F90)		CoNiCrMo (F562)		CoNiCrMoWFe (F563)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Cr	27.0	30.0	19.0	21.0	19.0	21.0	18.00	22.00
Mo	5.0	7.0	—	—	9.0	10.5	3.00	4.00
Ni	—	2.5	9.0	11.0	33.0	37.0	15.00	25.00
Fe	—	0.75	—	3.0	—	1.0	4.00	6.00
C	—	0.35	0.05	0.15	—	0.025	—	0.05
Si	—	1.00	—	1.00	—	0.15	—	0.50
Mn	—	1.00	—	2.00	—	0.15	—	1.00
W	—	—	14.0	16.0	—	—	3.00	4.00
P	—	—	—	—	—	0.015	—	—
S	—	—	—	—	—	0.010	—	0.010
Ti	—	—	—	—	—	1.0	0.50	3.50
Co	Balance							



The abrasive wear properties of the forged CoNiCrMo alloy are alike to that of the cast CoCrMo alloy (about 0.14 mm/year in co-simulation tests with the ultra-high molecular weight polyethylene acetabular cup); nevertheless, the earlier is not suggested for bearing surfaces of joint prostheses due to poor frictional properties with itself or with other materials. The structure of Wrought CoNiCrMo alloy makes it suitable for applications requiring extensive service life without fracture or stress fatigue. Since it is very hard to eliminate the failed implant part buried deep in the femoral medullary canal, it is better understood when the implant needs to be replaced. In addition, revision arthroplasty is generally inferior in function to primary surgery due to weaker fixation of the implant.

Metallic products released from the prosthesis due to wear, corrosion and abrasion can damage organs and local tissues. In vitro investigations have exposed that particulate Co is toxic to human osteoblast-like cell lines and inhibits type I collagen, osteocalcin and alkaline phosphatase synthesis in culture. However, particulate Cr and CoCr alloys are well tolerated by cell lines without significant toxicity. In vitro toxicity of metal extracts, they stated that 50% concentration of Co and Ni extracts appeared quite toxic, since all viability parameters changed after 24 hours. However, Cr extract appears to be less toxic than Ni and Co [7].

The modulus of elasticity of CoCr alloys does not change with changes in ultimate tensile strengths. Values range from 220 to 234 GPa, which is greater than stainless steel. While the effect of increased modulus on the fixation and longevity of implants is unclear, this may have some effect of different modes of load transfer to bone in artificial joint replacements. Low wear (mean linear wear on the MeKee-Farrar component was 4.2  $\mu\text{m}/\text{year}$ ) has been recognized as an advantage of metal-to-metal hip joints due to its stiffness and durability [8].

### Ti-alloys

Titanium and its alloys are progressively utilized in medical implants because of their outstanding biocompatibility, corrosion resistance and relatively low density. Like stainless steels, titanium alloys form passive films on their surfaces - in this case a  $\text{TiO}_2$  film, which is the source of corrosion resistance. Like iron, titanium is polymorphic. As the schematic phase diagram shows (Fig. 5), the low temperature phase of titanium alloys is  $\alpha$ -Ti with HCP crystal.

The structure and high temperature phase is  $\beta$  - Ti with BCC crystal structure. At ambient temperature, we can have  $\alpha$ -Ti single phases or  $\alpha + \beta$  phase or even  $\beta$ -Ti single-phase titanium alloys, depending upon the chemical composition of the alloy. Elements used to stabilize  $\beta$  phase include aluminum and tin. Elements that can stabilize the  $\beta$  phase are including vanadium molybdenum, chromium and niobium.

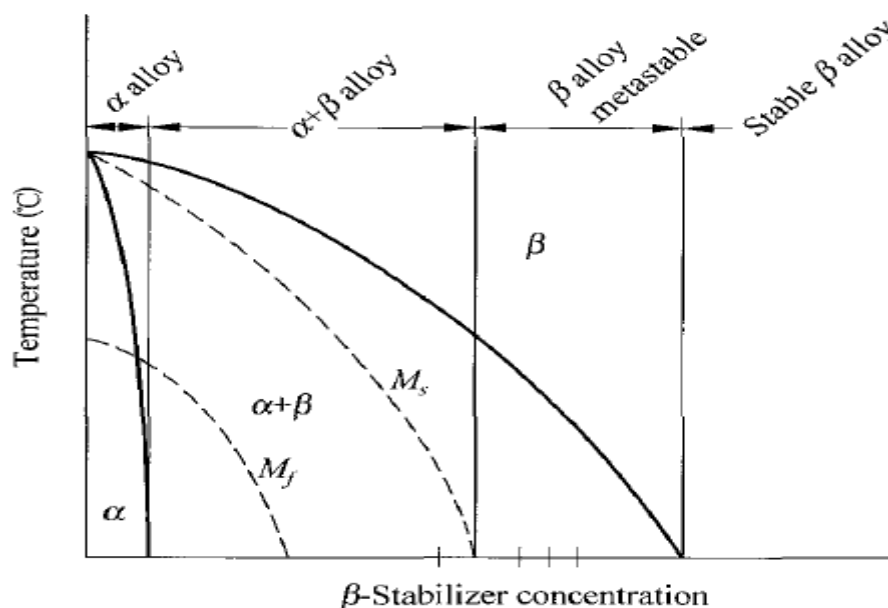


Figure 5 Schematic phase diagram of titanium alloy.

Titanium material is used for implants as it is the most resistant to corrosion. Ti CP has four grades based on trace element content. Grade 4 (Ti CP-4) has the highest levels of oxygen, iron and carbon trace elements. Such elements are called interstitial elements in titanium as they form interstitial solid solutions. Titanium alloys are named according to their composition, eg. G. Ti - 6Al - 4V contains 6% by weight aluminum and 4% by weight vanadium. Ti - 6Al - 4V  $\alpha + \beta$  alloy and is the utmost extensively utilized titanium alloy due to its high. force. Medical grade Ti - 6Al - 4V has extremely low content of interstitial (ELI) elements. Ti -13Nb -13Zr, a relatively new  $\alpha + \beta$  alloy, uses niobium as a  $\beta$ -phase stabilizer and exhibits interestingly low elastic modulus. Impurities such as intermediate elements significantly affect the mechanical properties of titanium and its alloys. Therefore, their contents are strictly controlled during manufacture.

The mechanical properties of titanium alloys are abridged in Table 2. The mechanical properties of Ti CP are dependent on cold working and annealing conditions for a given degree of interstitial element levels. Fully annealed Ti CP-4-coaxial grains exhibit lower strength than cold worked ones. The mechanical properties of Ti - 6Al - 4V with coaxial  $\alpha$ -phase grains exhibit higher strength and ductility than pointed grains. However, the acicular structure increases resistance to fracture or cracking. The cast counterpart is lower in mechanical properties as presented in Table 2. Note that Ti - 13Nb - 13Zr exhibits low Young's modulus while maintaining the same power as Ti - 6Al - 4V. Its low Young's modulus is suitable for medical implants.

Table 2 Mechanical properties of Ti and Ti alloys for medical implants

Alloys	Treatment Condition	ASTM Designation	Young's Modulus (GPa)	Yield Strength (MPa)	Tensile Strength (MPa)	Ductility (% elongation)
Ti CP-4	Annealed	F67	110	480	550	15
Ti - 6Al - 4V ELI	Forged and annealed	F136	110	825	890	14
	Casting		110	758	827	13
Ti - 13Nb - 13Zr	Aged	F1713	79	725	860	8

### 3-D PRINTERS

Three-dimensional printing (3DP) is a term in material production and is the result of recent research for material scientists. It is estimated that this technology has shown significant growth over the last few years and will revolutionize the manufacturing industry to create a new generation of high performance materials [9,10]. Customization, rapid prototyping, automated production and flexibility in reducing complex geometries at relatively low cost and time during the design phase have encouraged and brought to the spotlight the remarkable advancement of 3DP.

In order to increase the performance of plastic composite, different reinforcement; for example, carbon black, platelets, chopped fibers, polymer fibrils, mixed with the hermoelastic matrix and then co-extruded during printing. The performance of these composites is strongly dependent on the fiber orientation in the plastic and fiber volume fraction (FVF). However, they still exhibit lower mechanical performance than conventional fiber reinforced composites. Therefore, in order to expand the application of 3D printed FMD technology to design high performance composites, it requires continuous fiber reinforced composite printing. The commercially available technology with this feature is known as continuous filament production (CFF) [11].

Exposure to exponential research over the last decade has resulted in numerous research articles and patents. Figure 6 illustrates the trend of scientific papers based on 3DP technology (a) and continuous fiber reinforced 3DP (b). In determining that published patents are used as keywords in the Web of science search engine, headings containing '3D printing \* / additive \* production \*' are counted and reported in Figure 6. These findings are compiled to meticulously understand the scopes and limitations for the future research on demand. The flow of this article begins with the history of 3DP and the

continuous fiber-reinforced composite manufacturing mechanism, followed by our recommendations for materials used, investigated properties, future appearance and future research.

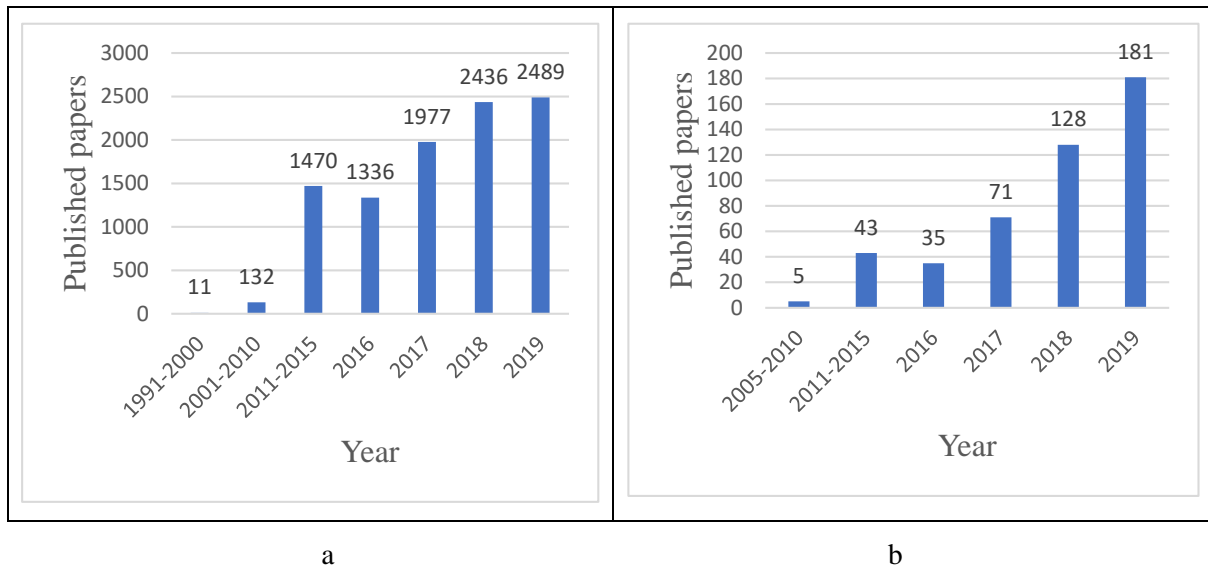


Fig. 6. An overview of the number of published papers regarding 3DP (a) and composite and 3DP (b) since their inceptions.

## History

The history of 3DP is only a 40-year-old technology [11]. The revolutionary growth of research in science, engineering and technology has brought this innovation to mature level. During the important period of its history, 3D printers were unsuitable, but now the price has dropped tremendously from about \$ 20,000 (before 2009) to \$ 500-1000 [11]. In order to better understand the development of 3BP, this article covers the timeline-based history as well as significant developmental stages.

### 2001–2010

Functional flexibility, mass customization, precision, high resolution, personal home printers, user-friendliness, and easy accessibility along with the explosion of research to produce new materials with sophisticated product characteristics are key developments that have occurred over the course of this decade [12]. In 2001, Envisiontec launched Perfactory Machine, which can produce exceptionally large parts at high speeds with precision and precision. In the following years, the metal powder and multicolor 3D melting commercial electron beam melting system was discovered by Z Corp printer. One of the groundbreaking ideas of the decade was the RepRap project, which brought the 3D printer with an easily accessible open source system and self-replicating nature at home [13]. Remarkably, the material developments in this decade were: 3D printed kidney, human blood vessel, 3D printed prostheses without first assembly, creation of consumer products, first garment (3D printed bikini), 3D printed films for 3D moving films, and 3D printed by first Chinese researcher's furniture. Another important event of this decade was the expiration of the patent of the FDM method, which expanded accessibility. Then thousands of stakeholders around the world began to use and experience technology easily. In addition, the growth of materials at that time and the widespread adoption of this technology by stakeholders followed the development of the first ASTM standard for additively manufactured products as quality and terminology reference [12].

### 2011-to-date

The history of this period is often concerned with the cost-effectiveness of 3D printers and the ability to use this technology for first-class materials that come out for multi-dimensional purposes, ranging from personal products to industrial products such as food, toys, jewelery, automobiles, buildings, aircraft. clothing and fashion accessories, biomedical and robotics [14]. The cost of FDM 3D printers has decreased from five to four or even three between 2012 and 2013, which has increased the affordability of this technology [15]. Increasing research risks associated with this amazing technology include Urbee

(first 3D printed car), Cornell University and NASA's 3D food printer, making vehicles on demand, 3D printed rocket fuel injector, moon space made by the European Space Agency (ESA), and 3D printed splint that caused lifesaving. President Obama has announced that he has granted a \$ 30 million research grant to the National Institute of Additional Production Innovation in Ohio to motivate AM and 3DP research in the United Nations Union State. As a result, many “wow” factors have not yet undergone 3DP technology [16].

### **Continuous filament fabrication**

#### **Mechanism**

The basic working procedures for creating an object using 3DP technology are the same in all existing technologies and consist of three basic steps. 3D model creation, slicing and printing [17]. First, it requires the development of a virtual 3D object using CAD software, which can create a comprehensive file format that is easily readable to the slicing software. Slicing software is designed to work on every 2D layer of an object's 3D model, processing and transmitting this information to the printer for printing to the physical structure [18]. Printing technology differs from one another, mainly due to the printing mechanism and the physical forms of the starting materials.

Figure 7 (a) shows a schematic representation of the continuous fiber production method using conventional 3D printers with modified print heads. Unlike shredded fiber reinforced composites, it has two separate materials for matrix / plastic / resin and reinforcing filament. The extrusion nozzle receives both thermoplastic polymer and continuous fibers, and continuous fibers are made to pass through the core of the nozzle. As a result, when the nozzle is heated, matrix infusion occurs and the molten thermoplastic material is deposited together with the reinforcing filament. The temperature of the nozzle is selected according to the thermal properties of the thermoplastic polymer. As soon as the material is deposited and reaches the print bed, it quickly solidifies and adheres to the previous layer. The print head is designed to move in 2D movements, ie in X-Y directions, and is responsible for the design of each layer according to the trajectory of the 3D CAD model transmitted with slicing software. The third movement up to a distance equal to the layer thickness along the Z direction is performed by the building platform after each platform is constructed; this continues until the structure is completed [19].

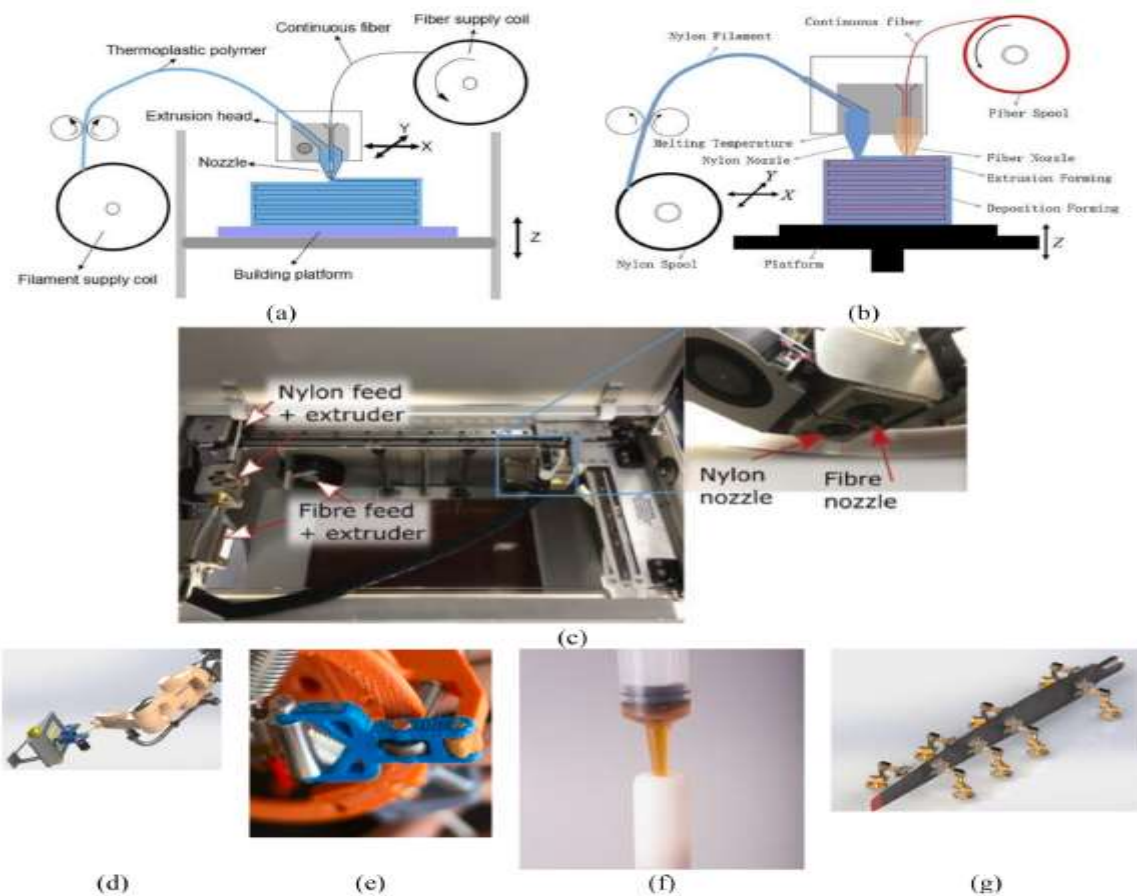


Fig. 7. Schematic representation of the FMD 3DP process using continuous filament with a printing head of single nozzle (a), reprinted with permission from (Emerald Publishing Ltd.) and dual nozzles (b), reprinted with permission from (Elsevier Ltd.), a close look of Markforged dual nozzle system (c) robotic printing head with coaxial extruder (d), molding roller (e), capillary injection method (f) and printing head with multiple extruders (g) [19].

### Factor affecting quality

The characteristics and properties of the printed parts depend on a number of factors, which can be divided into three main stages: preparation, printing and finishing. Goh et al. [20] provide definitions of terms contained in 3DP factors. Detailed production factors affecting the mechanical properties of the 3D printed composite in the FDM process Banjanin et al. [21]. Figure 8 compiles and classifies almost all possible factors related to the quality and performance of 3D printed composites found in the literature.

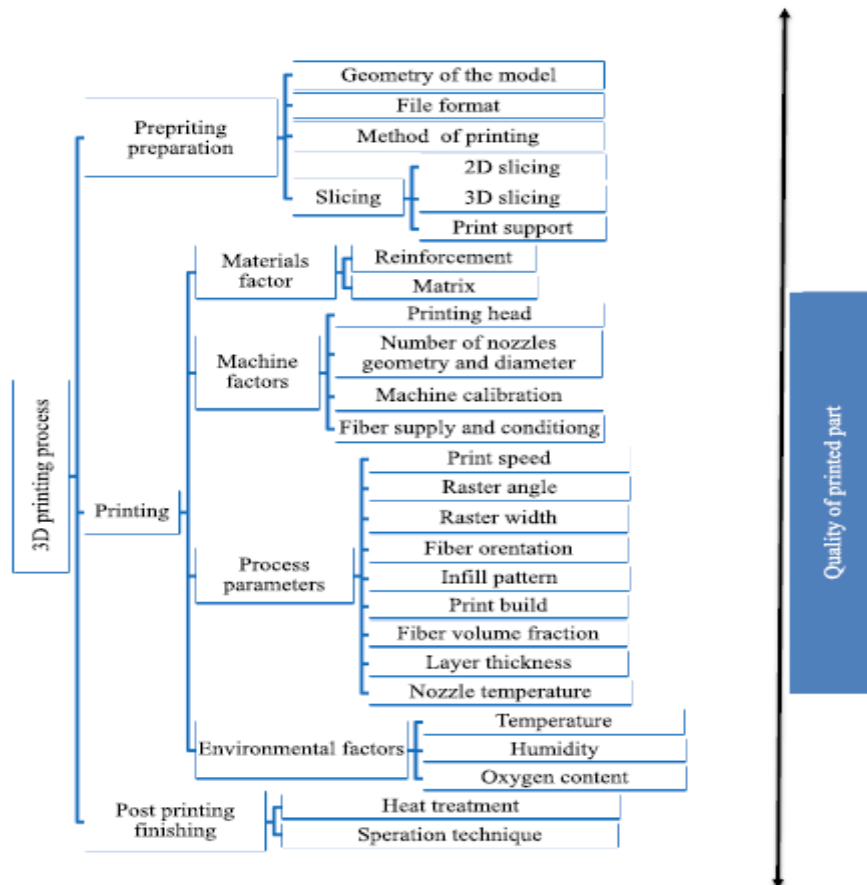


Fig. 8. List of preparatory, machine, process and environmental factors affecting quality of 3D printed composites [9].

**Preparatory factors** → (file format, slicing software)

**Printing factors** → (nozzle temperature, heating mechanism, diameter and geometry; moisture and electrical property; viscosity and rheology; print speed, raster angle, fiber orientation, infill patterns; ambient temperature and humidity)

**Finishing factors** → (print bed, special glue, support material, heat treatment, separation technique)

### Materials

Obviously, the CFF comprises both the matrix and the reinforcement, whereas the reinforcing material is always a continuous fiber. The matrix holds the fibers firmly for long-term serviceability, and protects the fibers from corrosion, deterioration, abrasion, etc. It is a base material that protects from external forces. Furthermore, the role of the matrix material is very important in carrying the compression load of the composites. On the other hand, incorporation of the reinforcement into the plastic matrix synergistically improves the final properties of the composites in terms of their tensile, elastic and load bearing capacity. In the manufacture of a composite, the choice of matrix and reinforcement is physically (good adhesion), chemically (matrix and fiber should not chemically react) and thermally (similar thermal behavior; coefficient of thermal expansion) [22]. Materials and properties used for 3D printed CFF are summarized in Table 3.

Table 3 Materials used for continuous filament fabrication [9]

Materials		Properties			
		Density in g/cm <sup>3</sup>	Diameter in $\mu\text{m}$ (number of mono filaments, diameter)	Tensile modulus in GPa	Flexural modulus GPa
Matrix	Onyx	1.2	1750	1.4	2.9
	Nylon	1.1	1750	0.94	0.84
	PLA	1.25	1750	2.02	2.392
	ABS	1.04	1750	0.998	1.9
	Epoxy	1.54	1750	3.5	
	PEEK	1.3	1750	3.6	
Continuous filament	Carbon	1.4/1.3	400 (1000, 10)	54	51
	Kevlar	1.2	300 (1000, 12)	27	26
	Fiberglass	1.5	300 (1000, 10)	21	22
	Jute	1.3-1.45	20-200	39.4	

In addition to polymer filament preparations, polymer processing factors such as melting temperature, viscosity, rheology and solidification are as important as the mechanical properties of the polymers and play an important role in the performance of a printing (mechanical properties, solubility and accuracy) section [23]. Fuenmayor et al. [24] and Rahim et al. [25] elaborated polymer preparation requirements and process-related considerations for the FDM 3DP system. Polymer filament preparations include polymer morphology, filament hardness, softness, brittleness, dimensional consistency, and appropriate winding on the reel. The desired polymer morphology for FDM / FFF is amorphous, so it can undergo rapid cooling and eventually helps to achieve better dimensional accuracy of the printed parts. In this regard, polyamides are preferred over other semi-crystalline and crystalline polymers because they have amorphous structures. Semi-crystalline polymers of low crystallinity (20-32%), such as PEEK, can also be used depending on the molecular structure and the structure of the cooling, since polymers with a high degree of crystallinity tend to cause part bending after printing [21]. The diameter of the polymer filament ( $1.75 \pm 0.1$  mm) should be equal, coiled parallel to the spool to minimize the tension of the filament, and should not be brittle or too soft to prevent friction and prevent friction. The polymer filament must be rigid enough to maintain the extruded deposition rate as it exerts pressure on the fluidizer [24].

## CONCLUSIONS

The following conclusions were drawn from this study:

- a) Different material systems have different advantageous properties. For example, metallic materials are widely known for their high ductility, strength and toughness; Their excellent mechanical properties added to their good corrosion resistance make them an ideal material for bone and joint replacement and bone fracture fixation. Ceramic materials stand out with their hardness and low wear rates; While they are not as fracture resistant as metals, they have the highest compressive strength, so ceramics are extensively utilized in load bearing implants. Polymers may not be as strong as metals and ceramics, but they are the most broadly utilized materials in healthcare because of their versatility and other valuable properties.
- b) Metals are used as biomaterials due to their excellent mechanical, thermal and electrical conductivity. Owing to its excellent mechanical properties and corrosion resistance, some metals are used as hip and knee joints, spine fixation devices, and dental implants. Some metallic alloys are used for catheter guide wires, orthodontic wires and vascular stents. For biomaterials in the body, stainless steel, cobalt alloys, titanium alloys, as well as magnesium, gold and silver alloys can be used.
- c) Biodegradable metals such as magnesium are particularly promising in applications that support tissue regeneration and healing where load-bearing function is required. It is highly suitable for producing fully resorbable intravascular stents for the treatment of arterial disease, minimizing the risk of chronic inflammation associated with permanent metallic stent implantation. However, to truly facilitate the clinical application of Mg-based bioabsorbable devices, more extensive in vitro and in vivo studies are needed to definitively confirm the safety of such devices. It has also been found that some Fe and some Fe-based alloys are biodegradable.
- d) Biomaterials have been utilized for hundreds of years, but it was only in the last century that

polymeric-based materials began to be widely used in the field of biomaterials. Synthetic polymers began to be used for medical purposes in the 1920s. From the 1930s to the 1950s, the most widely used polymeric biomaterial was poly(methyl methacrylate) due to its biocompatibility. This material is still used today for prosthetic eyeballs, bone cements and intraocular lenses.

e) Embedding continuous fiber into the plastic resin of the 3D printed model is a very new and promising innovation to dictate a new generation of composites due to its significant contribution to the enhancement of mechanical properties such as tensile, bending, compression and impact.

f) Significant improvements of up to several layers compared to non-reinforced composites can allow CFF composites to serve for high load carrying purposes.

g) Commercial application is very narrow due to the limited range of materials (matrix and reinforcement) to personalize the anisotropic behavior, poor interface bond, high porosity and composite properties as needed.

h) The mechanical procedure of the 3DP device and the 3DP principle, meso and microstructural studies show poor mechanical performance compared to conventionally prepared composites.

i) Time, cost and scalability are of great concern. The CFF composite research is a new application or discovery stage that often underlines changing printing and processing parameters as well as reinforcement configurations, rather than replacing existing materials.

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**ANTIBACTERIAL EFFECT WOUND DRESSING OBTAINED FROM CROSS-LINKED  
PVA/NaCAS/Ag NP ELECTROSPUN MATS**

**ÇAPRAZ BAĞLI PVA/NaCAS/Ag NP ELEKTROSPUN MATLARDAN ELDE EDİLEN  
ANTİBAKTERİYEL ETKİLİ YARA ÖRTÜSÜ**

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**ABSTRACT**

In this study, mixtures of polyvinyl alcohol (PVA) and sodium caseinate (NaCAS, SK) were prepared at a ratio of 60/40 (w/w). Silver nanoparticles (Ag NPs) were added at the rates of 1%, 3%, 5%, and 7% according to the amount of the total solid. The electrospinning process was applied to the prepared solutions without waiting. Then, the obtained nanofibers were dipped into the glutaraldehyde bath and cross-linked. FTIR, EDX, DSC, moisture test, and antibacterial test against *E.coli* bacteria were applied to nanofibers. In the FTIR results, the new peak at 2868 cm<sup>-1</sup> belonging to (CH<sub>2</sub> or CH<sub>3</sub>-CHO) aldehyde groups was attributed to the occurrence of cross-linking. According to EDX results, %0.42, %2.14, %3.27, and %4.82 values of Ag element were seen in the structure of electrospun mats, respectively. The lower values were attributed to the non-homogeneous distribution of Ag NPs in the test region. T<sub>m</sub> value increased to 197°C in DSC results due to the addition of the SK to the PVA structure. Even, the T<sub>m</sub> value increased up to 223°C with the effect of cross-linking. T<sub>m</sub> temperature of 7% Ag NP added nanofiber decreased to 199°C. The moisture content test results showed that while uncross-linked PVA/SK nanofibers absorbed at approximately 3.5% rates moisture, other nanofibers did not absorb moisture. Compared with the results of our previous study, the higher SK content in the structure reduced the moisture content. According to the antibacterial test results performed according to the agar plate colony counting method, all Ag NP-added nanofibers showed 100% antibacterial activity against *E.coli* bacteria at the 24<sup>th</sup>, and 48<sup>th</sup> hours. In this study, it was predicted that the obtained nanofibers can be used as an antibacterial effective wound dressing with further tests.

**Keywords:** PVA, NaCAS, AgNP, Cross-Linked, Electrospun Mat, Antibacterial

**ÖZET**

Bu çalışmada polivinil alkol (PVA) ve sodyum kazeinat (NaCAS, SK) karışımları 60/40 (w/w) oranında hazırlandı. Gümüş nanopartiküller (Ag NP) toplam katı miktarına göre %1, %3, %5 ve %7 oranlarında eklenmiştir. Hazırlanan solüsyonlara bekletilmeden elektroçekim işlemi uygulandı. Daha sonra elde edilen nanolifler glutaraldehit banyosuna daldırılarak çapraz bağlanmıştır. Nanoliflere FTIR, EDX, DSC, nem testi ve *E.coli* bakterilerine karşı antibakteriyel test uygulandı. FTIR sonuçlarında, (CH<sub>2</sub> veya CH<sub>3</sub>-CHO) aldehit gruplarına ait 2868 cm<sup>-1</sup>'deki yeni pik, çapraz bağlanma oluşumuna bağlanmıştır. EDX sonuçlarına göre elektrospun hasırların yapısında sırasıyla %0.42, %2.14, %3.27 ve %4.82 Ag elementi değerleri görülmüştür. Düşük değerler, Ag NP'lerin test bölgesindeki homojen olmayan dağılımına bağlanmıştır. SK'nın PVA yapısına eklenmesi nedeniyle DSC sonuçlarında T<sub>m</sub> değeri 197°C'ye yükselmiştir. Çapraz bağlanmanın etkisiyle T<sub>m</sub> değeri 223°C'ye kadar yükselmiştir. %7 Ag

NP katkılı nanolifin  $T_m$  sıcaklığı 199°C'ye düşmüştür. Nem içeriği testi sonuçları, çapraz bağlı olmayan PVA/SK nanoliflerinin yaklaşık %3,5 oranında nem emerken, diğer nanoliflerin nemi emmediğini gösterdi. Önceki çalışmamızın sonuçlarıyla karşılaştırıldığında, yapıdaki SK içeriğinin yüksek olması nem içeriğini azaltmıştır. Agar plak koloni sayım yöntemine göre yapılan antibakteriyel test sonuçlarına göre Ag NP katkılı tüm nanolifler 24. ve 48. saatlerde *E.coli* bakterilerine karşı %100 antibakteriyel aktivite göstermiştir. Bu çalışmada elde edilen nanoliflerin antibakteriyel etkili bir yara örtüsü olarak kullanılabilceği ileri testler ile öngörülmüştür.

**Anahtar Kelimeler:** PVA, NaCAS, AgNP, Çapraz Bağlı, Elektrospun Mat, Antibakteriyel

## GİRİŞ

Elektroçekim yöntemiyle üretilen nanolifler, özellikle yüksek yüzey/hacim oranı gibi oldukça üstün avantajları sayesinde modern yara örtülerinden beklenen özellikleri doğal yapısında barındırmaktadır. Böylece, tıp uygulamalarında kullanım alanı bulmaktadır. Antibakteriyel etkili yara örtüsü üretimleri ise, piyasadaki antibiyotikler yapıya emdirip veya antibakteriyel etkinliğe sahip katkı maddeleri eklenerek elde edilmektedir. Örnek olarak, povidon-iyot geleneksel yara örtülerinde kullanılırken, modern yara örtülerinde ise genellikle gümüşün kullanımı tercih edilmektedir [1]. Yüzyıllardan beri gümüş, antifungal, antiseptik, antiinflamatuvar özellikleri ile yanık, kazalı yara veya cerrahi yara durumlarında açığa çıkan yüksek bakteriyel enfeksiyonun tedavi edilmesinde geniş spektrumlu bir antibakteriyel/antimikrobiyal ajan olarak kullanılmaktadır [2]. Gümüş nanopartiküller (Ag NP'ler) ise, gümüşün diğer formlarıyla kıyaslandığında, yüksek yüzey alanları sayesinde mikroorganizmalara karşı daha etkili antibakteriyel/antimikrobiyal etkinlik göstermiştir.

Bir süt proteini olan kazein, kanın pıhtılaşması için aktifleşen bir bileşendir. Sodyum kazeinat (SK) proteini de, kazein yapısının suda çözünebilir formunu oluşturur. Sahip olduğu doğal özellikleri dolayısıyla tıbbi uygulamalarda kullanımı uygun görülmektedir. SK yapısı tek başına elektroçekimlenme işlemine uygun değildir, bu sebeple moleküler dolanmayı kolaylıkla sağlayarak lif yapısı oluşturabilen bir polimer ile karıştırılarak elektroçekimlenmesi uygun görülmektedir. Bu çalışmada, belirtilen özellikleri taşıyabilen matris destek polimeri olarak Poli(vinil alkol) (PVA) kullanılmıştır.

PVA, suda çözünebilir, yüksek hidrofilik özelliğe sahip, biyobozunur ve biyouyumlu, lif oluşturma kabiliyeti yüksek sentetik bir polimer yapısına sahip olduğundan karışım matrisi olarak kullanılması tercih edilmektedir. Ancak, PVA yapısının yüksek hidrofilik olması, dolayısıyla yüksek suda çözünürlük göstermesi kullanım alanlarını kısıtlamaktadır [3]. Aynı zamanda SK proteini de suda çözündüğünden, karışım sonrası yapıların hidrofilik özelliklerini iyileştirerek suda çözünmeyen bir yapı elde etmek amacıyla çapraz bağlama işlemi uygulanması tercih edilmektedir.

PVA ve SK yapılarını çapraz bağlamak için, glutaraldehit (GLA) çapraz bağlayıcı ajanı kullanılmaktadır. GLA yapısındaki amino grupları hidroksil grupları ile hızlı bir şekilde tepkimeye girerek aldehit gruplarını oluşturur ve ayrıca protein zincirleri arasında kovalent bağ oluşumuna olanak sağlamaktadır. Tüm bu açılardan tercih edilen GLA, antibakteriyel aktiviteye sahip olması ve toksik etki göstermesi sebebiyle de kullanım alanları sınırlanmaktadır. Çözelti hazırlama esnasında GLA'nın çözelti içerisine eklenmesi düşük çapraz bağlama ve yüksek toksik etki açığa çıkarması nedeniyle tıbbi uygulama alanlarında kullanılamayacak olması önceki çalışmalarda belirtilmiştir [4]. Bu nedenle bu çalışma kapsamında; nanoliflerin daldırma yöntemi ile çapraz bağlanması tercih edilmiştir. Bu çalışmada, belirli bir PVA/SK karışımına farklı yüzde oranlarında Ag NP'ler eklenerek hazırlanan çözeltilerden elektroçekim yöntemiyle elde edilen nanoliflerin çapraz bağlanması sayesinde; hidrofilik özellikleri gelişmiş böylece suya dayanıklılığı artmış antibakteriyel aktiviteye sahip nanolif yara örtüsü malzemeleri üretilmiştir.

## MATERYAL VE METOT

SK proteini, Acros Organics ve PVA, Kuraray Poval şirketinden satın alınmıştır. Glutaraldehit (%50 aqua solution)) Thermo Scientific firmasından temin edilmiştir. Aseton, etil alkol ve hidroklorik asit

(HCI) Sigma-Aldrich şirketinden; fosfat tampon çözeltisi de Farma şirketinden tedarik edilmiştir. 28-48 nm boyutundaki Ag NP'ler Nanografi'den satın alınmıştır.

Bu çalışmada, PVA ile SK yapıları ağırlıkça 60/40 oranında karıştırılarak, toplam katı miktarına göre 1%, 3%, 5% ve 7% Ag NP katkıları ilave edilerek polimer çözeltileri hazırlanmıştır. Çözündürme işlemi önce 1 saat oda sıcaklığında, ardından 10dk 30°C'de, 10dk 40°C'de, 10dk 50°C'de ve 1 saat 60°C'de olmak üzere 30dk daha 80°C'de manyetik karıştırıcıda beherin ağız sıkıca kapalı olacak şekilde aralıksız karıştırılmıştır. Toplam 3 saatin sonunda tamamen homojen çözeltiler hazır hale getirilmiştir. Hazırlanan çözeltiler bekletilmeden elektroçekim işlemine alınmıştır. Elektroçekim çalışma koşulları 13 cm mesafe, 18kV uygulanan gerilim ve 1.00 ml/h olarak belirlenmiştir. Tüm nanolifler aynı koşullarda üretilmiştir ve üretilen nanolif kodları Tablo 1'de verilmiştir. Ardından, elde edilen nanoliflere daldırma yöntemi ile çapraz bağlama işlemi uygulanmıştır. Çapraz bağlama işlemi için GLA çözeltisi, önceki çalışmalarımızda kullanılan reçeteye uygun şekilde hazırlanmıştır [4].

Tablo 1. Elektropsun Matların Çalışma Kodları

Çalışma Kodları	PVA/SK (w/w)	Ag NP (%)	GLA Çözeltisi
PVA-SK	60/40	-	-
CrLi-PVA-SK		-	Daldırıldı
CrLi-1Ag		1	Daldırıldı
CrLi-3Ag		3	Daldırıldı
CrLi- 5Ag		5	Daldırıldı
CrLi-7Ag		7	Daldırıldı

Elde edilen matların karakterizasyon testleri ve uygulama alanına yönelik analizler; Fourier Dönüşümlü Kızılötesi Spektroskopisi (FTIR), Enerji Dağılımlı X-Işını Spektroskopisi (EDX), Diferansiyel Taramalı Kalorimetresi (DSC), Nem İçeriği Testi (Nİ) ve Antibakteriyel Test ile gerçekleştirilmiştir.

Tüm nanoliflerin yapısındaki bağların ve karışımların bileşenleri arasında meydana gelen olası etkileşimlerin belirlenmesi için Perkin Elmer Spectrum 100 cihazı ile FTIR analizi gerçekleştirilmiştir. Nanomalzemelerin yapısındaki Ag elementinin (%) olarak belirlenmesi, QUANTA 400F Field Emission marka SEM cihazına bağlı EDX ile gerçekleştirilmiştir.

Nanoliflerin ısı özelliklerinin incelenmesi amacıyla DSC analizi, 25-300°C sıcaklık aralı ve 10°C/dk ısıtma hızıyla, test alanına 30ml/dk akış hızı ile yüksek saflıkta azot gazı beslenmesiyle gerçekleştirilmiştir. Nanoliflerin neme karşı dayanımını ve nem emilim miktarının belirlenmesi amacıyla nem içeriği testi Rhim metoduna uygun gerçekleştirilmiştir [5]. Her nanoliften üçer adet olmak üzere 1 cm<sup>2</sup> boyutlarında kesilerek, ilk ağırlıkları (Mi) tartılarak not edildi. Ardından 24 saat 105°C'de 24 saat vakum etüvünde kurutmaya bırakılmıştır. Kuruyan nanolifler yeniden tartıldı (Ms) ve aşağıdaki formüle (1) göre MC hesaplandı.

$$MC = \frac{Mi - Ms}{Mi} * 100 \quad (1)$$

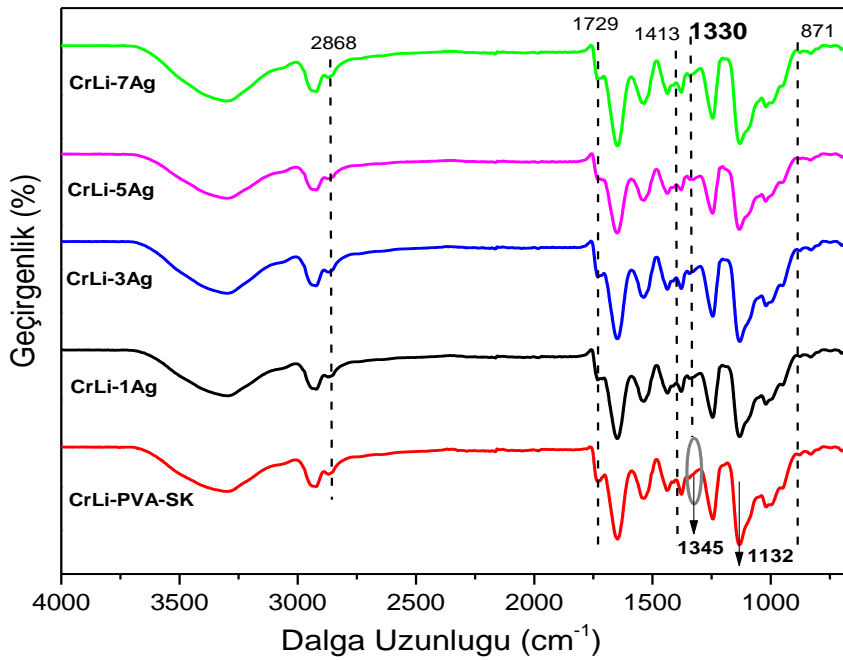
Elde edilen nanoliflerin in vitro antibakteriyel aktivite incelemesi, Gram negatif bakterilere (E. coli ATCC 25922) karşı agar plaka koloni sayımı yöntemi ile değerlendirilmiştir. 1x1 cm boyutlarındaki nanoliflerin her iki yüzü de UV ışıkta 30 dk sterilize edilmiştir. Gece boyunca 37°C'de yapılan inkübasyon 0 saat, 12 saat, 24 saat ve 48 saat için gerçekleştirildi. Agar plakalarında üreyen ve üremeyen bakteriler sayıldı. İşlem üç kez tekrarlandı. Aşağıdaki denkleme (2) göre nanoliflerin antibakteriyel aktivitesi (%) hesaplanmıştır [6].

$$\text{Antibakteriyel Aktivite (\%)} = (A-B)/A \times 100 \quad (2)$$

A, kontrol olarak kullanılan antibakteriyel aktivitesiz nanolifin bakteri sayısıdır. B, 0 saat dışında en az bakteri sayısıyla saat başına ortalama bakteri sayısıdır.

## ARAŞTIRMA VE BULGULAR

PVA-SK karışımı hazırlanan nanoliflerin kimyasal bağ yapılarına ait yeni bağlar ve çapraz bağlama işleminin etkisiyle ortaya çıkan yeni grupların oluşumlarını gösteren yeni piklerin varlığı tüm nanoliflerin FTIR spektrumları ile Şekil 1’de incelenmiştir. Çapraz bağlama işlemi sonrası  $2868 \text{ cm}^{-1}$  dalga boyunda görülen pik GLA’nın aldehit gruplarına (-CHO grubu) atfedilmiştir. Çapraz bağısız PVA-SK nanolifinde bu pik belirgin değildir, sadece ( $\text{CH}_3$ ,  $\text{CH}_2$ ) grubuna ait olan bağları gösterdiği düşünülmektedir. PVA-SK nanolifinde görülmeyen ancak tüm çapraz bağlı nanoliflerde  $1729 \text{ cm}^{-1}$  dalga boyunda görülen pikte ( $\text{C} = \text{C} - \text{CO} - \text{O}-$ ) grubuna ait olarak gözlemlenmiştir.

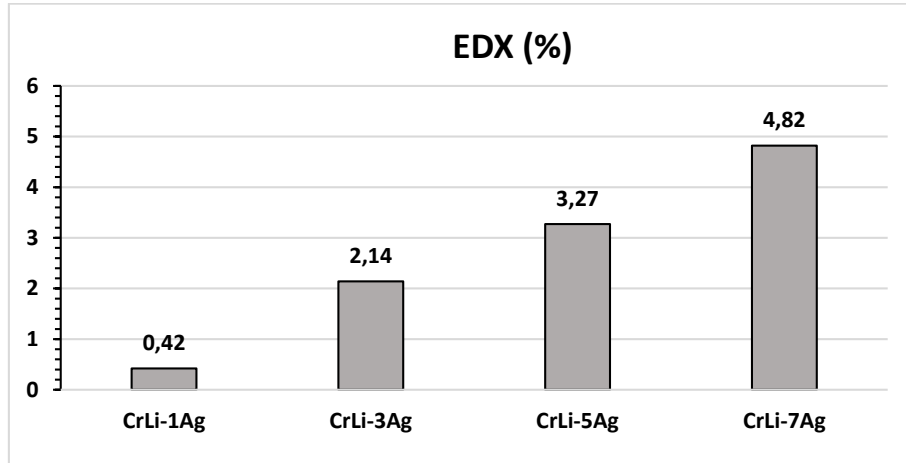


Şekil 1. Çapraz bağlı nanoliflerin FTIR analizi

Çapraz bağısız PVA-SK nanolifte olmayan ancak tüm çapraz bağlı nanoliflerde,  $1413 \text{ cm}^{-1}$  dalga boyunda görülen pikin, ( $\text{O}=\text{C}=\text{O}$ ) grubuna ait olduğu görülmüştür. Ayrıca, PVA-SK nanolifinde görülen ( $-\text{OH}$ ) grubuna ait  $1330 \text{ cm}^{-1}$  dalga boyundaki PVA’nın karakteristik piki; CrLi-PVA-SK nanolifinde  $1345 \text{ cm}^{-1}$  dalga boyuna kaymıştır. Ardından Ag NP katkılı nanoliflerde bu pik yine  $1330 \text{ cm}^{-1}$  dalga boyunda görülmüştür. Bu durum Ag ile OH grupları arasındaki etkileşim ile açıklanmaktadır. PVA-SK nanolifinde görülen ( $-\text{C}-\text{O}-\text{H}-$ ) grubuna ait  $1084 \text{ cm}^{-1}$ ’teki pik çapraz bağlandıktan sonra tüm nanoliflerde  $1132 \text{ cm}^{-1}$ ’e kaymıştır.

PVA-SK, CrLi-PVA-SK, CrLi-1Ag, CrLi-3Ag ve CrLi-7Ag nanoliflerinde  $871 \text{ cm}^{-1}$  dalga boyunda görülen aromatik C-H bağı, CrLi-5Ag nanolifinde ise tamamen kaybolmuştur. Bu durum, yapıdaki Ag NP miktarı arttıkça absorbans değerini düşürdüğü ile ilişkilendirilmiştir. Absorbans değeri düşüşü, PVA ile Ag NP arasındaki yan zincirlerinin kimyasal bağ yapmasıyla açıklanmıştır [7].

PVA-SK karışımına çözelti halindeyken, karışımdaki toplam katı miktarına göre hesaplanarak %1, %3, %5 ve %7 Ag NP katkısı eklenmiştir. Yapıdaki Ag elementinin yüzde (%) varlığını tespit etmek için nanoliflere EDX analizi yapılmıştır. EDX analizine ait sonuçlar Şekil 2’deki grafikte verilmiştir.



Şekil 2. Ag Katkılı Nanoliflerin EDX (%) Sonuçları

%1, %3, %5 ve %7 Ag NP katkıli nanoliflerde sırasıyla %0.42, %2.14, %3.27 ve %4.82 Ag elementi değerleri saptanmıştır. Toplam katı miktarı katkısına göre sırasıyla %58, %28.67, %34,60 ve %31,14 eksik oranlarda Ag elementi varlığı raporlanmıştır. Yapıdaki bu farklılığın sebebi, homojen dağılım gösteremeyen aglomera Ag NP'lere atfedilmiştir. Ag NP'lerin test yapılan bölgeler harici, yapının farklı bölgelerinde birikerek topraklanma yapmış olduğu söylenebilir. Bununla birlikte eksik değeri en az olan nanolif CrLi-3Ag numunesinde görülmüştür. Bu nanolif yapısındaki Ag NP'lerin dağılımlarının diğer nanoliflerinkine göre daha homojen olduğu ve bu sayede toplam katı miktarına en yakın değeri gösterdiği vurgulanabilir. Bu sonuçlar, ileri karakterizasyon testleri olan SEM analizi ile yüzey görüntüleri sayesinde ve TGA analizindeki kalıntı miktarları ile doğrulanabilir.

Nanoliflerin DSC eğrilerinden elde edilen  $T_g$  ve  $T_m$  değerleri Tablo 2'de verilmiştir. PVA'nın  $T_g$ 'si 80°C civarı sıcaklık değeri [4] gösterirken, SK'nın  $T_g$ 'si de 75°C civarı [8] sıcaklık değeri göstermektedir. PVA-SK ve çapraz bağlı tüm karışımli nanoliflerde birbirine yaklaşan  $T_g$  değerleri görülmüştür. Bu durum iki polimerin birbiri ile etkileşerek uyumluluk göstermesine atfedilmiştir.

Tablo 2. Nanoliflerin DSC Isıl Değerleri

Numuneler	$T_g$ (°C)	$T_m$ (°C)
PVA-SK	83,57	197,44
CrLi-PVA-SK	79,69	223,89
CrLi-1Ag	76,56	219,82
CrLi-3Ag	80,13	222,11
CrLi-5Ag	75,46	220,26
CrLi-7Ag	89,86	199,46

Saf PVA'nın  $T_m$  değeri 190°C civarında [4] ve literatürde saf SK'nın  $T_m$  değeri 125-145°C civarında [8, 9] görülmektedir. Çapraz bağısız PVA-SK nanolifinin  $T_m$  değeri karışımın etkisiyle 197°C'ye kadar artış göstermiştir. Hatta CrLi-PVA-SK nanolifi ve Ag NP katkıli olan CrLi-1Ag, CrLi-3Ag ve CrLi-5Ag nanoliflerinin  $T_m$  değerleri 220°C sıcaklık değerleri civarına artarak ısıl özelliklerde keskin bir artış görülmüştür. Bu artış çapraz bağlanmanın etkisiyle yapıda artan aldehit gruplarının varlığı ve hidroksil gruplarının azalması sayesinde gelişen ısıl davranışa atfedilmiştir. Ancak yapıya eklenen Ag NP katkılarının %5 Ag NP katkısına kadar nanoliflerin  $T_m$  değeri üzerinde herhangi bir etkisinin olmadığı

saptanmıştır. Çünkü  $T_m$  değerlerinde bir değişiklik görülmemiştir. Bu durum yapıdaki Ag NP'lerin doygunluğa ulaşarak ve protein yapısını değiştirerek ısı özelliklerinde düşüşe sebep olmasıyla ilişkilendirilmiştir [10].

Nem içeriği test sonuçlarına göre, çapraz bağlı olmayan PVA/SK nanoliflerinin yaklaşık %3,5 oranında nem emdiği gözlemlenmiştir. Diğer tüm çapraz bağlanmış nanoliflerin oda sıcaklığındaki ortam nemini (yaklaşık %65 bağıl nem) emmediğini görülmüştür. Bu sonuç çapraz bağısız karışım nanolifin %3,5 nem çeken hidroksil gruplarının çapraz bağlanmanın etkisiyle parçalanarak bir başka grup olarak yapıya katıldığını göstermiştir.

Ag NP katkılı PVA-SK nanoliflerinin antibakteriyel etkinliğinin değerlendirilmesi, bir Gram-negatif bakterisi olan *E.coli* üzerinde gerçekleştirilmiştir. Antibakteriyel aktivite (%) sonuçları 0., 12., 24. ve 48. saatler için Tablo 3'te raporlanmıştır. Test esnasında, PVA-SK nanolifi kısa bir süre içinde çözündüğü için test sonuçlarına dahil edilmemiştir.

CrLi-PVA-SK nanolifi kontrol numunesi olarak belirlenmiştir. CrLi-PVA-SK nanolifinde 0.saat itibarıyla antibakteriyel etkinlik görülmemiştir. %1 Ag NP katkılı nanolifte 12. saatte başlayan antibakteriyel aktivite %89,5 olarak gözlemlenirken; 24. ve 48. saatte %100 antibakteriyel etkinliğe ulaştığı görülmüştür. Aynı şekilde %3 Ag NP katkılı nanolifte 12. saatte başlayan antibakteriyel aktivite %99,43 olarak görülürken; 24. ve 48. Saatteki antibakteriyel aktivitenin %100'e ulaştığı gözlemlenmiştir. CrLi-5Ag ve CrLi-7Ag nanolifleri ise, 12. 24. ve 48. saatlerde %100 antibakteriyel etkinlik sergilemiştir. Antibakteriyel test sonuçlarına göre, tüm nanoliflerde *E.coli*'ye karşı antibakteriyel etkinlik bulunmaktadır. Tüm nanomalzemelerin 48 saat yani 2 güne kadar antibakteriyel etkili yara örtüsü olarak kullanılabilmesi öngörülmektedir. Ancak yara örtüsü olarak kullanılacak malzemenin toksik etkisinin olmaması ve %70 (ve üzeri) hücre canlılığı özelliği göstermesi gerekmektedir. Bu üretilen nanomalzemelerin antibakteriyel etkili yara örtüsü olarak kullanılabilirliği ileri bir test olan sitotoksikite testleri ile belirlenerek saptanacaktır.

Tablo 3. Nanomalzemelerin *E.coli*'ye karşı antibakteriyel etkinliği (%)

Numuneler	0 saat	12 saat	24 saat	48 saat	Antibakteriyel Aktivite (%)
CrLi-PVA-SK	57	250	sayılamaz	sayılamaz	---
CrLi - 1Ag	54	5,67	0	0	12. saat için 89,5 24 ve 48 saatleri için 100
CrLi - 3Ag	58,33	0,33	0	0	12. saat için 99,43 24 ve 48 saatleri için 100
CrLi - 5Ag	53	0	0	0	12, 24, 48 saatleri için 100
CrLi - 7Ag	56	0	0	0	12, 24, 48 saatleri için 100

#### 4. SONUÇ

Bu çalışmada, PVA ve SK karışımları 60/40 (w/w) oranında hazırlanmıştır. Karışımdaki toplam katı miktarına göre %1, %3, %5 ve %7 Ag NP'ler eklenmiştir. Hazırlanan çözeltilerden elektroçekim yöntemiyle nanolifler üretilmiştir. Elde edilen nanolifler glutaraldehit çözeltisinde çapraz bağlanmıştır. Nanoliflerin FTIR sonuçlarında, 2868 cm<sup>-1</sup> dalga boyundaki yeni pik aldehit grupları ile ilişkilendirilerek çapraz bağlanma oluşumuna atfedilmiştir. Toplam katı miktarına göre katılan %3 Ag NP'lerin en homojen dağılım sağlayarak CrLi-3Ag nanolifinde EDX sonuçlarında %2.14 değer gösterdiği bulunmuştur. DSC sonuçlarındaki T<sub>m</sub> değeri PVA ve SK karışımı ile 197°C'ye yükselmiştir. Çapraz bağlanma ile T<sub>m</sub> değeri CrLi-5Ag nanolifinde 223°C sıcaklığa kadar artmıştır. Nem içeriği yüzdesine göre PVA/SK elektrospun matlar yaklaşık %3,5 oranında nem tutarken, tüm çapraz bağlı nanoliflerin nemden etkilenmediği gözlemlenmiştir. Agar plak koloni sayım yöntemiyle gerçekleştirilen *E.coli*'ye karşı Ag NP katkılı tüm nanolifler 24. ve 48. saatlerde %100 antibakteriyel etkinlik sergilemiştir.

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**USE IN BIOMEDICAL AREAS OF CROSS-LINKED PVA/NaCAS/R-GO  
NANOMATERIALS PRODUCED WITH ELECTROSPINNING**  
**ELEKTROÇEKİM İLE ÜRETİLEN ÇAPRAZ BAĞLI PVA/NaCAS/R-GO  
NANOMATERYALLERİN BİYOMEDİKAL ALANLARDA KULLANIMI**

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## ABSTRACT

In this report, Reduced Graphene Oxide (RGO) at rates of 1%, 3%, 5%, and 7% were added to blends of sodium caseinate (NaCAS, NC) and polyvinyl alcohol (PVA) prepared as 40/60 (w/w). Nanofibers that were obtained from these solutions by electrospinning were treated with a glutaraldehyde bath for cross-linking. Mechanical, total soluble matter, porosity, and cytotoxicity (cell viability for 24h) tests were carried out on the obtained nanofibers. The tensile strength of uncross-linked nanofiber decreased from 3.04 MPa to 1.39 MPa after cross-linking. However, elongation behaviour increased from 4.50% to 34.67%. After adding RGO to nanofibers, their tensile strength increased. Only the tensile strength of 7% RGO added mat remained below that of cross-linked nanofiber. The elongation behaviour of nanofibers also decreased. It was found that the elongation behaviour of only 1%RGO added mat was higher than that of uncross-linked nanofiber. At the end of the total soluble matter test, uncross-linked nanofiber was completely dissolved. Cross-linked mats lost only 13.61 % of the weight. Similar results were obtained when 1%, 5% and 7% RGO were added to the structure. While the porosity of uncross-linked nanofibers was 75%, it increased to 110% after cross-linking. However, after adding RGO, the porosity was reduced by up to 85%, although still high value. This case can be explained by the fact that RGO particles embedded in nanofibers shut pores, causing the passage to be blocked. The L929 fibroblast cell viabilities were determined as 74% (1% RGO), 70% (3% RGO), and 67% (5% and 7% RGO). According to these results, 1% and 3% RGO-added nanofibers can be used as wound dressings. The usability of nanofibers as an antibacterial effective wound dressing will be evaluated with further tests.

**Keywords:** Sodium Caseinate, Polyvinyl Alcohol, Reduced Graphene Oxide, Nanofiber, Cell Viability, Biomedical Nanomaterials

## ÖZET

Bu raporda, 40/60 (w/w) olarak hazırlanan sodyum kazeinat (NaCAS, NC) ve polivinil alkol (PVA) karışımlarına %1, %3, %5 ve %7 oranlarında İndirgenmiş Grafen Oksit (RGO) eklenmiştir. Bu çözeltilerden elektroçekim ile elde edilen nanolifler, çapraz bağlanma için bir glutaraldehit banyosu ile muamele edildi. Elde edilen nanolifler üzerinde mekanik, toplam çözünür madde, gözeneklilik ve sitotoksitesite (24 saat hücre canlılığı) testleri yapılmıştır. Çapraz bağlanmamış matın çekme dayanımı, çapraz bağlanma sonrasında 3,04 MPa'dan 1,39 MPa'ya düşmüştür. Ancak uzama davranışı %4,50'den %34,67'ye yükseldi. Nanoliflere RGO eklendikten sonra çekme dayanımı arttı. Sadece %7 RGO eklenmiş matın çekme dayanımı, çapraz bağlı nano elyafın altında kalmıştır. Nanoliflerin uzama davranışı da azalmıştır. Sadece %1 RGO katkılı nanolifin uzama davranışının çapraz bağlı olmayan

nanoliften daha yüksek olduğu bulundu. Toplam çözünür madde testi sonunda çapraz bağlanmamış nanolif tamamen çözünmüştür. Çapraz bağlı matın ağırlığın sadece %13.61'ini kaybetti. Yapıya %1, %5 ve %7 RGO eklendiğinde de benzer sonuçlar elde edilmiştir. Çapraz bağlanmamış nanoliflerin gözenekliliği %75 iken çapraz bağlanma sonrasında %110'a yükselmiştir. Bununla birlikte, RGO eklendikten sonra, hala yüksek bir değer olmasına rağmen, gözeneklilik %85'e kadar azaltılmıştır. Bu durum, nanoliflerin içine gömülmüş RGO partiküllerinin gözenekleri kapatarak geçişin tıkanmasına neden olmasıyla açıklanabilir. L929 fibroblast hücre canlılıkları %74 (%1 RGO), %70 (%3 RGO) ve %67 (%5 ve %7 RGO) olarak belirlendi. Bu sonuçlara göre %1 ve %3 RGO katkılı nanolifler yara örtüsü olarak kullanılabilir. Nanoliflerin antibakteriyel etkili bir yara örtüsü olarak kullanılabilirliği ileri testler ile değerlendirilecektir.

**Anahtar Kelimeler:** Sodyum Kazeinat, Polivinil Alkol, İndirgenmiş Grafen Oksit, Nanolif, Hücre Canlılığı, Biyomedikal Nanomalzemeler

## GİRİŞ

Modern yara tedavisinde öncelik yara yüzeyinin doğru şekilde değerlendirilebilmesi, ihtiyaçlarının belirlenebilmesi ve yara yüzeyinin nemli tutulabilmesidir. Bunun yanında yara yüzeyini yabancı maddelerden ve bakteriyel enfeksiyonlardan korumak, yara yüzeyinde bulunan fazla eksuda sıvısını gidermek, yara yüzeyinde gaz alışverişine izin vermek ve yara çevresinde bulunan sağlıklı doku hücrelerine zarar vermemek ideal bir yara bakım malzemesinden beklenen özelliklerin başlıcalarıdır [1, 2]. Bu beklenen gereksinimleri karşılamak için modern yara örtüleri geliştirilmektedir. Elektroçekim yöntemiyle elde edilen nano/mikrolifler doğal yapıları sayesinde bu beklenen özellikleri karşılamakta ve geniş yüzey alanı/hacim oranı, yüksek gözeneklilik ile yüksek hava geçirgenliği gibi üstün özellikler sergilemektedir [3, 4]. Hem sentetik hem de doğal polimerlerin bir arada kullanılmasıyla elde edilen kompozit yara örtüleri [5], etken katkı maddelerin varlığında hazırlanan modern yara örtüleri arasındadır.

Polivinil alkol (PVA), biyolojik olarak parçalanabilen ve biyouyumlu bir polimer olması sayesinde modern yara örtüsü kullanımlarında tercih edilmektedir [6]. PVA, iyi kimyasal direnç ve fiziksel özelliklere sahip toksik olmayan sentetik bir polimerdir. Tehlikesizdir, bu nedenle kullanımı güvenli ve çevre dostu olarak kabul edilir. Yarı kristal bir yapıya sahiptir. Bu özellikleri ve iyi ısı kararlılığına sahip olması nedeniyle endüstriyel alanda kullanımı oldukça fazladır. Ayrıca PVA polimer zincirleri içerisinde çok sayıda bulunmakta olan hidroksil grubu nedeniyle yüksek hidrofilik özellik gösterir [7].

Doğal bir süt proteini olan sodyum kazeinat (NaCAS, NC) kazeinin suda çözünen bir formunu oluşturur. Kazeindeki amino asitlerin %55'inden fazlası polar yan grupları yapısında barındırmaktadır. Bu gruplar, %26 –COOH (karboksilik asit), %15 –NH<sub>2</sub> (amin) ve %15 –OH (hidroksil) olarak açıklanabilmektedir. Polar olan gruplar, kazein proteini yapısındaki moleküllerin, moleküller arası ve molekül içi hidrojen bağı meydana gelmesine sebep olmaktadır. Kazein çözeltilerinin lifli formda elde edilememesinin sebebi polimerin küresel yapılarından, protein moleküllerinin oldukça güçlü moleküler içi ve moleküller arası kuvvetlerden kaynaklanan yüksek elastikiyeti ile ilişkilendirilmiştir. NC bireysel olarak elektroçekim yöntemi ile lif haline getirilememektedir. Moleküller arası ve moleküler içi bağ yoğunluğu azaltıldığı takdirde, hazırlanan çözeltiler de elektroçekimlenebilir olacaktır. Bunun için, üç boyutlu yapıyı kesintiye uğratma, protein moleküllerini ayırma, farklı bir yapıya ve proteinlerle ikincil bağ oluşturma yeteneğine sahip farklı bir polimer ile harmanlanması uygun görülmektedir [8]. PVA moleküler dolanma yeteneğini artırarak yüksek lif oluşturma yeteneğine sahip olduğundan NC ile karışımli olarak kullanıldığında elektroçekimlenebilir bir hal alacağı öngörülmüştür [9, 10].

Bu çalışmada, NC nanoliflerinin üretilmesi için PVA destek polimeri olarak kullanılacaktır. PVA'nın yüksek hidrofilikliği ve NC'nin suda çözünebilmesi kullanım alanlarını sınırlamaktadır. Suda çözünme yeteneği azaltılmış nanomalzemelerin geliştirilmesi için, çapraz bağlanması amaçlanmıştır. PVA ve NC polimerleri ile indirgenmiş grafen oksit (RGO) katkı maddesi karışımlarının elektroçekim ile işlenmesiyle oluşan nanolifler, glutaraldehit (GLA) banyosu içinde bekletilerek çapraz bağlanacaktır. Bu daldırma yöntemi ile toksik olmayan, yarayı nemli tutabilecek kadar çapraz bağlanmış ve mekanik

özellikleri gelişmiş hasta konforu sağlayan yara örtüsü nanomalzemelerinin elde edileceği öngörülmektedir [11].

Mükemmel antimikrobiyal özelliklere sahip olmasına rağmen, zayıf dağılılabirliği ve işlenebilirliği nedeniyle grafen bazlı malzemeler üzerindeki çalışmalar sınırlı kalmıştır. Bu çalışma ile, biyobozunur ve biyoyumlu PVA ile NC proteini ve RGO farklı oranlardaki katkı maddeleri kullanılarak antibakteriyel etkili toksik olmayan, yarayı nemli tutabilecek, yeterli elastikiyete sahip yara örtülerinin geliştirilmesi hedeflenmiştir. Bu sayede grafen bazlı nanomalzemelerin karakterizasyon çalışmaları ile de literatüre katkı sağlanması planlanmıştır.

## **MATERYAL VE METOT**

PVA polimeri ve NC proteini sırasıyla, Kuraray Poval ve Acros Organics firmasından tedarik edilmiştir. Gluteralehit (%50 aqua solution) Thermo Scientific'ten temin edilmiştir. Etil alkol, aseton ve hidroklorik asit (HCl) Sigma-Aldrich'den; fosfat tampon çözeltisi de Farma firmasından satın alınmıştır. İndirgenmiş grafen oksit (RGO) Nanografi'den temin edilmiştir.

Bu çalışma için, PVA ile NC polimerleri ağırlıkça 60/40 (w/w) oranında harmanlanarak, 1%, 3%, 5% ve 7% RGO katkı maddeleri eklenerek polimer solüsyonları hazır hale getirilmiştir. Polimer karışımlarını çözme işlemi oda sıcaklığında başlatılmıştır, 1 saat sonra sıcaklıklar 10'ar dk arayla 10'ar derece artacak şekilde kademeli olarak arttırılmıştır. 1 saat daha 60°C ve 30dk daha sonra 80°C'de olmak üzere, beherin ağzı sıkı bir şekilde kapalı olarak manyetik karıştırıcıda karıştırılmıştır. Toplamda 3 saat sonunda tamamen homojen olarak çözülmüş çözeltiler elde edilmiştir. Hazırlanan solüsyonlar bekletilmeksizin elektroçekim uygulamasıyla işlenmiştir. Elektroçekim prosesi; 18kV uygulanan gerilim, 1.00 ml/h ve 13 cm mesafe şartlarında çalışılmıştır. Tüm elektrospun matlar aynı şartlarda çalışılmıştır. Üretilen matlar GLA banyosunda daldırma yöntemiyle çapraz bağlanmıştır. Tablo 1'de çalışılan nanoliflerin kodları verilmiştir. GLA banyosu literatürdeki önceki çalışmalarımızdaki reçeteye uygun olarak hazır hale getirilmiştir [11]. Elde edilen matlara mekanik test, toplam çözünür madde testi, gözeneklilik testi ve sitotoksisite (hücre canlılığı) testi uygulanmıştır.

Mekanik test, ASTM D882 standardına göre ve 5 kN yük ile çalışan Lloyd Instruments LRX Plus Marka cihazda 1/10 mm/dk çekme hızında ve oda sıcaklığı içerisinde gerçekleştirilmiştir. Her nanoliften 5 numune çalışılmış ve ortalama alınmıştır [12].

Tablo 1. Çalışılan nanoliflerin kodları

<b>Çalışılan Numuneler</b>	<b>PVA/NC (w/w)</b>	<b>RGO (%)</b>	<b>GLA Banyosu</b>
<b>PVA-NC</b>	60/40	-	-
<b>PVA-NC-CRN</b>		-	Muamele edildi
<b>1RGO-CRN</b>		1	Muamele edildi
<b>3RGO-CRN</b>		3	Muamele edildi
<b>5RGO-CRN</b>		5	Muamele edildi
<b>7RGO-CRN</b>		7	Muamele edildi

Toplam çözünür madde miktarı testi (TÇMM), yine Rhim metoduna göre gerçekleştirilmiştir [13]. Her nanoliften üçer adet 1x1 cm numune kesilerek tartıldı ( $W_0$ ). Ardından nanolifler 30ml saf su içerisinde 24 saat bekletildi. Sonra, çözünmemiş nanolifler beherden çıkartılarak saf suyla durulandı. 105°C sıcaklıkta 24 saat vakumlu etüvde kurumaya bırakıldı. Kuruyan nanolifler yeniden tartılarak ( $W_f$ ), aşağıdaki formüle (1) göre hesaplandı.

$$T\text{ÇM} (\%) = (W_0 - W_f) / W_0 * 100 \quad (1)$$

Nanoliflerin gözenekliliği mutlak etanol ile doldurulmuş bir piknometre kullanılarak ölçülmüştür. Arşimet prensibine (sıvı yer değiştirme metodu) göre [14-17] gözeneklilik aşağıdaki formüle (2) göre hesaplanmıştır.

$$\text{Gözeneklilik} (\%) = (W_2 - W_3 - W_s) / (W_1 - W_3) * 100 \quad (2)$$

$W_1$ , mutlak etanol ile doldurulmuş piknometrenin ağırlığı;  $W_2$ , mutlak etanol ve nanolif ile doldurulmuş piknometrenin ağırlığı;  $W_3$ , etanolle ıslatılmış nanolif  $W_2$ 'den çıkarıldığında piknometre ve mutlak etanolün ağırlığı ve son olarak  $W_s$ , nanolifin kuru ağırlığıdır.

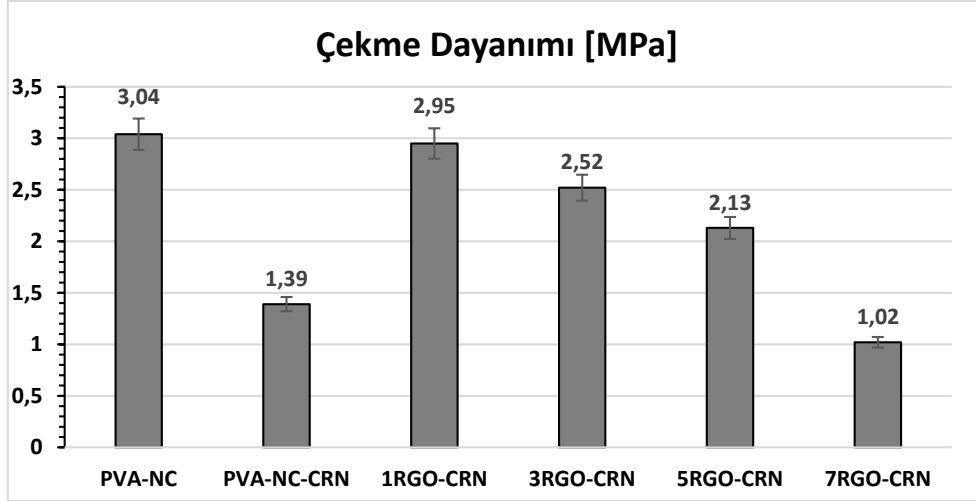
Sitotoksitesite testi (Hücre canlılığı testi), direkt kontakt test metoduyla WST-1 kullanılarak 24 saat süre için uygulanmıştır. Nanoliflerin yara örtüsü amacıyla kullanılabilirliğinin değerlendirilebilmesi, sitotoksitesite özelliklerinin fare fibroblast hücre hattı (L929, ATCC, CCL-1) için incelenmesiyle gerçekleştirilmiştir. Her bir nanolife ait 3 farklı ölçümün ortalaması alınmıştır [18]. Hücre canlılığı aşağıdaki formüle (3) göre hesaplanmıştır.  $A_b \text{ numune}$ , numune absorbansı;  $A_b \text{ blank}$ , boş kuyucuğun absorbansı;  $A_b \text{ negatif kontrol}$ , negatif kontrolün absorbansıdır.

$$\text{Hücre Canlılığı} (\%) = \frac{A_b \text{ numune} - A_b \text{ blank}}{A_b \text{ negatif kontrol} - A_b \text{ blank}} * 100 \quad (3)$$

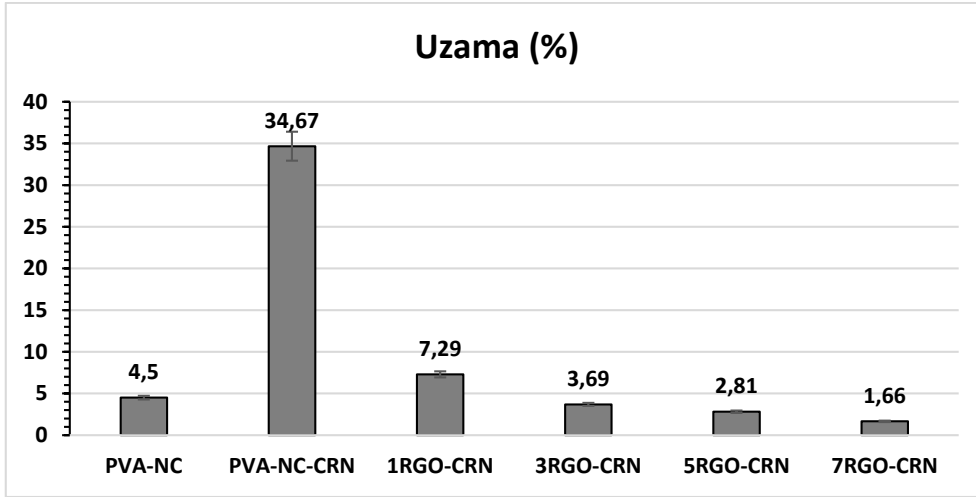
## ARAŞTIRMA VE BULGULAR

Nanoliflerin mekanik analiz sonuçlarından elde edilen çekme dayanımı (MPa) değerleri Şekil 1'de; uzama (%) değerleri Şekil 2'de ve modül (MPa) değerleri Şekil 3'te verilmiştir. PVA-NC nanolifinin çekme dayanımı 3,04 MPa iken; çapraz bağlandıktan sonra PVA-NC-CRN nanolifin çekme dayanımı 1,39 MPa'ya düşmüştür. Saf PVA-NC nanolifleri çapraz bağlama ile daha kırılabilir bir hal almıştır. Ancak uzama değerleri incelendiğinde, çapraz bağlandıktan sonra keskin bir artış görülmüştür. PVA-NC-CRN nanolifi PVA-NC nanolifinden yaklaşık 8 kat daha fazla uzama davranışı göstermiştir. Modül değerleri de çekme dayanımı ve uzama arasındaki ilişkiyi doğrular niteliktedir. Çekme dayanımı yüksek PVA-NC nanolifinin modül değeri 131,70 MPa iken, uzama değeri yüksek PVA-NC-CRN nanolifinin modül değeri 37,11 MPa olarak saptanmıştır.

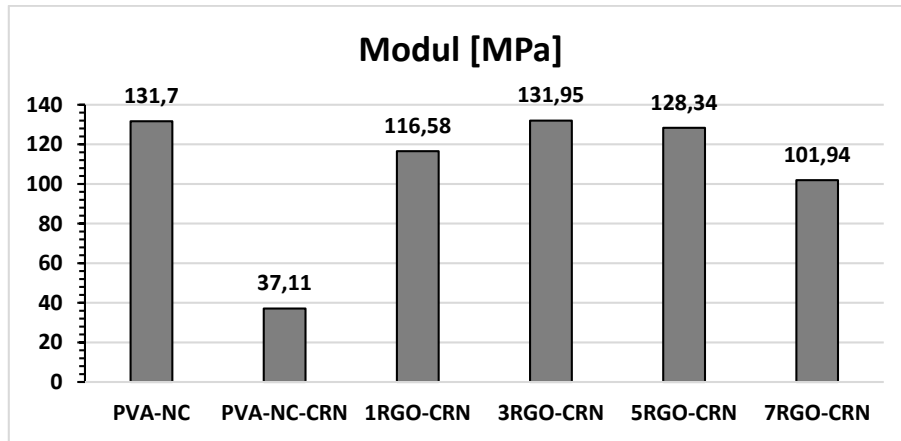
Yapıya RGO katkısı eklendikten sonra PVA-NC-CRN nanolif yapısına göre nanoliflerin çekme dayanımlarında artış görülmüştür. Ancak çapraz bağısız PVA-NC nanoliflerine göre tüm RGO katkılı nanoliflerin çekme dayanımları düşük değerler sergilemiştir. Sırasıyla 1RGO-CRN nanolifinin 2,95 MPa değeri; 3RGO-CRN nanolifinin 2,52 MPa değeri ve 5RGO-CRN nanolifinin 2,3 MPa değeri, PVA-NC-CRN nanolifinkinden yüksek çekme dayanımı göstermiştir. 7RGO-CRN nanolifinde ise çekme dayanımı değeri keskin bir düşüş göstererek 1,02 MPa'ya kadar gerilemiştir. Bu durum artan RGO miktarının nanolif yapısına kırılabilirlik özelliği verdiği düşünülmüştür. Ayrıca çekme dayanımına benzer şekilde nanoliflerin uzama davranışlarında da yapıdaki RGO miktarı arttıkça azalma meydana gelmiştir. Özellikle 3RGO-CRN nanolifi de dahil olmak üzere, 5RGO-CRN ve 7RGO-CRN nanoliflerinde hem PVA-NC-CRN nanolifine hem de PVA-NC nanolifine göre oldukça düşük değerlerde uzama davranışı izlenmiştir. Sadece 1RGO-CRN nanolifi PVA-NC nanolifinden yüksek uzama davranışı göstermiştir. Grafen doğal yapısı formu dolayısıyla yapıya çekme dayanımı kazandırırken uzama davranışını düşürmesi beklenmektedir. Özellikle modül değerleri göz önüne alındığında, nanoliflerin yüksek modülleri göze çarpmaktadır. Özellikle 3RGO-CRN nanolifi PVA-NC-CRN nanolifinden de bir miktar daha yüksek modül değeri göstermiştir. Bu değere en yakın 5RGO-CRN nanolifi modül değeri görülmüştür.



Şekil 1. Nanoliflerin çekme dayanımı [MPa]



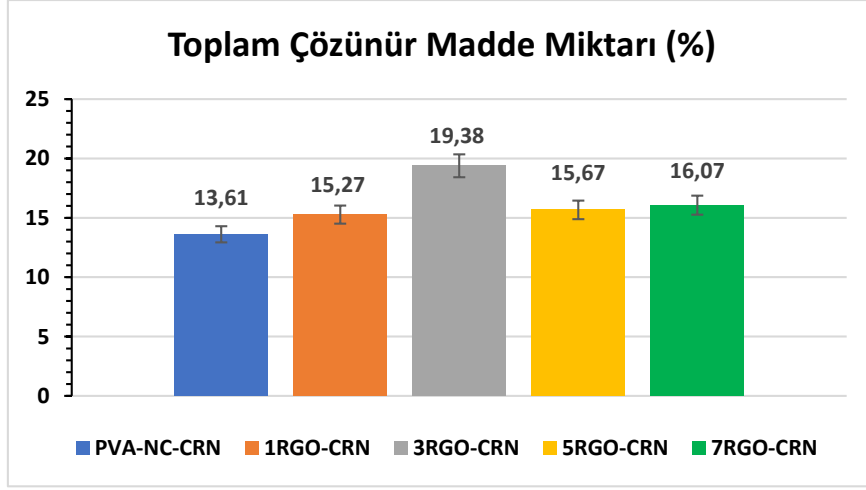
Şekil 2. Nanoliflerin (%) uzama değerleri



Şekil 3. Nanoliflerin modül değerleri

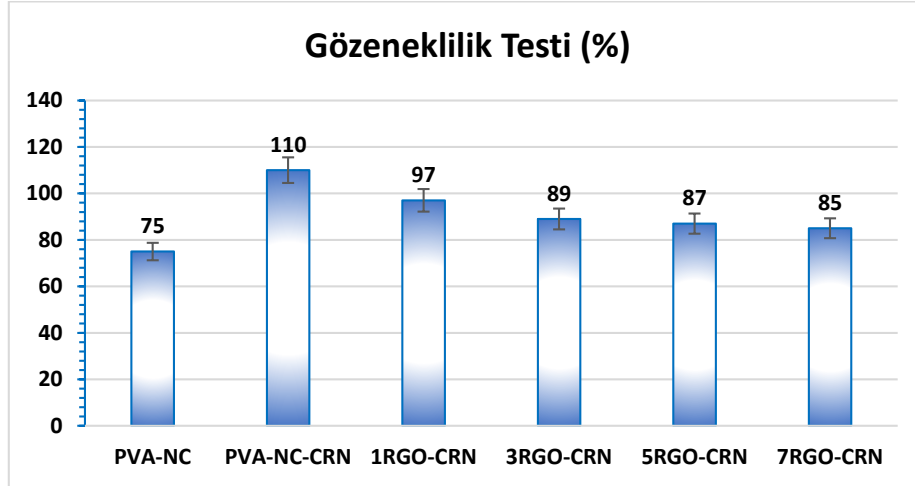
Nanoliflerin toplam çözünür madde miktarı (TÇMM) grafikleri Şekil 4'te verilmiştir. Test esnasında kısa bir süre içinde, çapraz bağlanmamış PVA-NC nanolifinin tamamen çözündüğü gözlemlenmiştir. Bu sebeple bu nanolif için TÇMM değeri hesaplanamamıştır. TÇMM sonuçlarına göre, PVA-NC-CRN nanolifleri %13,61'dir. Yapıya RGO katkı maddelerinin eklenmesiyle nanoliflerde TÇMM (%)'si artmıştır. 1RGO-CRN nanolifi %15,27; 3RGO-CRN nanolifi %19,38; 5RGO-CRN nanolifi %15,67 ve 7RGO-CRN nanolifi %16,07 TÇMM değerlerini göstermiştir. Bu durum yapı içerisindeki RGO'lerin

yüksek aglomere olma eğiliminde olmasıyla ilişkilendirilmiştir. Test bölgesinde topaklanan RGO katkıların, PVA ve NC yapılarının 24 saatin sonunda çözünme eğilimi ile bir anda yapıdan ayrılarak daha yüksek ağırlık kaybına sebep olduğu düşünülmüştür.



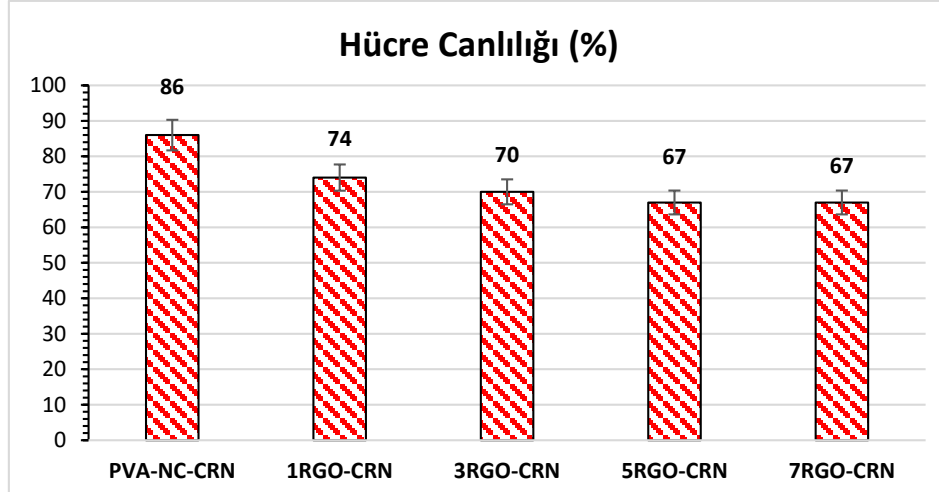
Şekil 4. Nanoliflerin TÇMM değerleri

Üretilen matların gözeneklilik değerleri Şekil 5’te verilmiştir. Nanolifler çapraz bağlandıktan sonra %110 ile en yüksek değeri göstermiştir. Ardından artan RGO miktarı ile nanoliflerin gözenekliliğinde bir azalma meydana gelmiştir. Bu durum, nanoliflerin arasına yerleşen RGO katkı maddeleri dolayısıyla, etanol sıvısının yapıdan geçecek yer bulamayarak gözenekliliği azalttığı şeklinde yorumlanmıştır. Ancak, ileri bir test olan SEM analizi ile nanoliflerin yüzey görüntüleri incelenerek; “nanolif çapları azaldıysa gözenekliliğin arttığı; nanolif çapları arttıysa gözenekliliğin azaldığı” şeklinde nanolif gözenekliliğini destekleyecek bilgiler edinilmesi de öngörülmüştür. Tüm bunların yanı sıra, PVA-NC-CRN nanolifinin PVA-NC nanolifinden önemli bir sıçrama ile yüksek değer sergilemesi, çapraz bağlanmanın etkisine atfedilmiştir. Önceki çalışmalarımıza göre daldırma yöntemi ile çapraz bağlanma, lif çapında az bir miktar artışa sebep olabileceği görülmüştür.



Şekil 5. Nanoliflerin gözeneklilik (%) değerleri

Nanoliflerin sitotoksitesite testi sonuçlarına göre hesaplanan hücre canlılık (%) değerleri Şekil 6’da gösterilmiştir. 24 saatin sonunda saf çapraz bağlı PVA-NC-CR nanolifinin %86 değeri ile en yüksek hücre canlılığını gösterdiği görülmektedir. Yapıya eklenen RGO katkı maddelerin miktarları arttıkça hücre canlılığında düşüş gözlemlenmiştir. Sırasıyla, 1RGO-CRN nanolifi %74, 3RGO-CRN nanolifi %70 ve hem 5RGO-CRN nanolifi hem de 7RGO-CRN nanolifi %67 hücre canlılığı göstermiştir. Bu sonuçlara göre RGO katkı maddelerinin toksik yapılı olduğu söylenebilir. Üretilen RGO katkılı nanoliflerin antibakteriyel aktiviteli yara örtüsü olarak kullanılabilirliği sitotoksitesitenin sonuçları doğrultusunda karar verilecektir.



Şekil 6. Nanoliflerin hücre canlılığı (%) değerleri

Bir malzemenin yara örtüsü olarak kullanılabilmesi, hücre canlılığının %70 ve üzerinde bir değer göstermesi gerektiği bilinmektedir. Bu durumda, eğer %1 ve %3 RGO katkıli üretilen nanolifler antibakteriyel aktivite gösterirse; yara örtüsü olarak sadece bu iki nanolifin kullanılabileceği vurgulanabilir. Aksi halde %5 ve %7 RGO katkıli nanolifler %70 değerinin altında bir hücre canlılığı değeri gösterdiği için yara örtüsü olarak kullanılamayacaktır.

## SONUÇ

Bu çalışmada, ağırlıkça 40/60 (w/w) olarak tartılan NC ve PVA karışımlarına %1, %3, %5 ve %7 oranlarında RGO katkı maddeleri de ilave edilerek çözeltiler hazırlanmıştır. Bu solüsyonlardan uygun elektroçekim koşullarında nanolifler üretilmiştir ve matlar GLA banyosunda bekletilerek çapraz bağlanmıştır. Çapraz bağlı olmayan nanolifin çekme dayanımı, 3,04 MPa iken; çapraz bağlama işlemi sonrasında 1,39 MPa'ya kadar azalmıştır. Uzama davranışı da %4,50'den %34,67'ye artmıştır. RGO ilavesiyle PVA-NC-CRN nanolifine göre nanoliflerin 7RGO-CRN nanolifine kadar çekme dayanımları artmıştır. RGO katkıli elektrospun matların uzama davranışı da azalmıştır. Sadece 1RGO-CRN nanolifinin uzama davranışının PVA-NC nanolifinden daha yüksek olduğu gözlemlenmiştir. Toplam çözünür madde miktarı testine göre çapraz bağlanmamış nanolifin tamamen çözündüğü görülmüştür. PVA-NC-CRN ve %1, %5 ve %7 RGO katkıli nanolifler yaklaşık %14 ( $\pm 2$ ) civarında TÇMM kaybetmiştir. PVA-NC nanolifinin gözenekliliği %75 iken; çapraz bağlanma sonrasında %110'a artmıştır. RGO ilavesiyle gözeneklilikte azalmalar gözlenirken, en düşük gözeneklilik %85 oranında 7RGO-CRN nanolifinde görülmüştür. Hücre canlılığı değerlerine göre 1RGO-CRN (%74) ve 3RGO-CRN (%70) nanolifleri 24 saatte bir değiştirilip yenilenmesiyle şartıyla yara örtüsü olarak kullanılabilir nitelikte olduğu raporlanmıştır. Ancak bu çalışma ile ilk kez üretilen bu nanomalzemelerin antibakteriyel etkili bir yara örtüsü olarak kullanılabilirliğinin değerlendirilebilmesi için; Gram negatif ve Gram pozitif bakterilerine karşı uygulanacak antibakteriyel testin gerçekleştirilmesi önerilmektedir.

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## DETAILED PARAMETER ANALYSIS FOR AFRICAN VULTURES OPTIMIZATION ALGORITHM

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### ABSTRACT

Metaheuristic algorithms are of great importance in solving optimization problems. In this study, the newly proposed African Vulture Optimization algorithm (AVO) has been examined. The AVO algorithm mimics the life-styles of African vultures and was created by imitating the foraging and wandering behavior of African vultures. Six kinds of fixed parameters (P1, P2, P3, L1, L2, w) are used in the algorithm. While the original paper examined the effect of these parameter values on AVO for only six types of values, nine types of effects were examined in this study (L1={0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2, 0.1}, L2={0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9}, P1={0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9}, P2={0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9}, P3={0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9}, w= {1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5}). The best parameter values were selected for AVO by examining the results. These parameters balance AVO's local and global search capabilities. According to the results, while the values of L1, L2, and w parameters were similar to the values in the original paper (L1=0.6, L2=0.4, and w=2.5), different appropriate values were determined for P1, P2, and P3 values (P1=0.4, P2=0.9, and P3=0.6).

**Keywords:** African vultures, Optimization, AVO

### INTRODUCTION

Metaheuristic algorithms have attracted the attention of many researchers in recent years. The success of metaheuristic algorithms in solving continuous and discrete problems is the basis for this. Continuous optimization problems are usually very complex. Mathematical methods often cannot find the optimal solution. Metaheuristic algorithms, on the other hand, can produce more powerful results for the solutions of continuous optimization problems. Mathematical methods have been used to solve many scientific and engineering problems and cover a wide range of different topics, but mathematical methods, despite their precision, still face many difficulties in solving many optimization problems (Abdollahzadeh, et al., 2021). Metaheuristic algorithms are created by imitating many situations. For example, natural events, creatures living in the form of flocks, mathematical facts, etc. Inspired by many natural phenomena, the heuristic algorithm uses their exploration and exploitation abilities to search for food sources. The success of such algorithms lies in balancing exploration and exploitation capabilities.

In recent years, the newly proposed African Vulture Optimization (AVO) algorithm is a heuristic algorithm created by mathematically modeling the lifestyles of African vultures. In recent years, many studies have been done with AVO. Khodadadi et al. proposed a new multi-objective artificial vultures optimization algorithm (Khodadadi et al., 2022). Alanazi et al. proposed an optimal reconfiguration of shaded PV based system using African vultures optimization approach (Alanazi et al., 2022). Xiao et al. proposed an improved hybrid Aquila Optimizer and African vultures optimization algorithm for global optimization problems (Xiao et al., 2022). Kumar and Mary proposed a study about parameter estimation of three-diode solar photovoltaic model using an Improved-African Vultures optimization algorithm with Newton-Raphson method (Kumar and Mary, 2021). Xi et al. proposed Binary African vultures optimization algorithm for various optimization problems (Xi et al., 2022).

In this study, a study that analyzes its parameters for AVO is presented. These parameters balance AVO's local and global search capabilities. There are six kinds of control parameters on AVO. These are P1,

$P_2, P_3, L_1, L_2,$  and  $w$ . In the original paper of AVO, these values were suggested as 0.6, 0.4, 0.6, 0.8, 0.2, 2.5, respectively.

### **AFRICAN VULTURES OPTIMIZATION ALGORITHM**

Vultures fall into two main categories. These are the new world vultures and the old world vultures. New-world vultures are found in America, while old-world vultures live in Europe, Asia, and Africa. The body of most vultures is not completely covered with feathers. There are no feathers on the neck and head. They feed on animal leaves. They don't nest. The basic principles of AVO to model AVO mathematically: (Khodadadi et al., 2022)

There are at most  $N$  (population numbers) vultures in a search space.

- The total number of vultures is divided into two main groups. In AVO, the fitness solutions of the whole population are first calculated. The first two best solutions are chosen and the first two vultures are determined. The remaining population members form a population that moves or replaces one of the two best vultures at each performance (Khodadadi et al., 2022).
- In AVO, the worst vulture is the weakest and most hungry vulture. Other vultures try to stay away from him. The best and strongest vulture are the first two vultures. Population members try to best approach the first two vultures (Khodadadi et al., 2022).

AVO is mathematically modeled in four steps.

#### **First scene:**

After the initial population is established, the fitness of all solutions is calculated and the best solution is chosen as the best vulture of the first group and the second best solution as the best vulture of the second group. Other population members try to move best towards the first two vultures. In each cycle, the fitness values are reapplied for the entire population. The work of approximating the best first two solutions of the other groups is calculated by Equation 1 (Khodadadi et al., 2022).

$$R(i) = \begin{cases} Vulture_{Best1} & \text{if } P_i = L_1 \\ Vulture_{Best2} & \text{if } P_i = L_2 \end{cases} \quad (1)$$

$$\text{Subject: } L_1 + L_2 = 1$$

$$P_i = \frac{F_i}{\sum_{i=1}^n F_i} \quad (2)$$

The probability of choosing one of the two best solutions is obtained by Equation 2 (Khodadadi et al., 2022).  $Vulture_{Best1}$  is the first best vulture of the group and  $Vulture_{Best2}$  is the second best vulture of group.

#### **Second scene:**

Equations 3-4 were used to move from the exploration stage to the exploitation stage, inspired by the saturation or hunger rates of the vultures. Vultures often forage for food, but fly longer distances if they are full. If a vulture is hungry, they don't have enough energy to fly for long periods and forage for food near the stronger vulture (Khodadadi et al., 2022). According to the  $|F|$  value, it moves to the third scene or fourth scene. If  $|F|$  value less than 1, AVO enters the exploration stage, otherwise AVO enters the exploitation stage (Khodadadi et al., 2022).

$$t = h \times \left( \sin^w \left( \frac{\pi}{2} \times \frac{iter_i}{Max\_iter} \right) + \cos \left( \frac{\pi}{2} \times \frac{iter_i}{Max\_iter} \right) - 1 \right) \quad (3)$$

$$F = (2 \times r_1 + 1) \times z \times \left(1 - \frac{iter_i}{Max_{iter}}\right) + 1 \quad (4)$$

$F$  indicates that the vultures are satiated.  $iter_i$  shows the current iteration number,  $Max_{iter}$  shows the maximum iteration number,  $z$  indicates a random number for range  $[-1, 1]$ ,  $h$  indicates a random number for range  $[-2, 2]$ , and  $r_1$  indicates a random number for range  $[0, 1]$  (Khodadadi et al., 2022).

**Third scene:** The exploration

At this stage, the discovery phase of AVOA is modeled. In the natural environment, vultures have high visual acuity and the ability to find food and spot poor dying animals. But finding food for vultures can be very difficult. Vultures carefully study their environment for a long time and travel long distances in search of food.

In AVO, vultures explore the search space based on two different situations. Here, the selection process for both states is made according to  $P_1$ . The discovery process in AVO is shown in Equations 5-8 (Khodadadi et al., 2022).

$$P(i + 1) = \begin{cases} Eq. (6) & \text{if } P_1 \geq Rand_{P_1} \\ Eq. (8) & \text{if } P_1 < Rand_{P_1} \end{cases} \quad (5)$$

$$P(i + 1) = R(i) - D(i) \times F \quad (6)$$

$$D(i) = |X \times R(i) - P(i)| \quad (7)$$

$$P(i + 1) = R(i) - F + r_2 \times ((ub - lb) \times r_3 + lb) \quad (8)$$

$F$  is the rate of the vulture being satiated and it is obtained using Equation 4.  $R(i)$  is obtained using Equation 1.  $X$  is a coefficient vector ( $X = rand \times 2$ ;  $rand$  indicates a random number for range  $[0, 1]$ ).  $P(i)$  is the current vector position of the vulture.  $r_2$  and  $r_3$  indicate a random number for range  $[0, 1]$ .  $ub$  and  $lb$  indicate upper and lower bounds (Khodadadi et al., 2022).

**Fourth scene:** The exploitation

In this subsection, local search operations are continued according to  $P_2$  and  $P_3$  values.

*Exploitation 1:* Exploitation 1 enters for AVO when the  $|F|$  value is between 1 and 0.5. Competition for Food is shown in Equations 10 and 11. The rotating flight of vultures is shown in Equations 12 and 13 (Khodadadi et al., 2022).

$$P(i + 1) = \begin{cases} Eq. (10) & \text{if } P_2 \geq Rand_{P_2} \\ Eq. (13) & \text{if } P_2 < Rand_{P_2} \end{cases} \quad (9)$$

$$P(i + 1) = D(i) \times F + (r_4) - d(t) \quad (10)$$

$$d(t) = R(i) - P(i) \quad (11)$$

$$S_1 = R(i) \times \left(\frac{r_5 \times P(i)}{2\pi}\right) \times \cos(P(i)) \quad (12)$$

$$S_2 = R(i) \times \left( \frac{r_6 \times P(i)}{2\pi} \right) \times \sin(P(i))$$

$$P(i + 1) = R(i) - (S_1 + S_2) \quad (13)$$

$F$  is the rate of the vulture being satiated and it is obtained using Equation 4.  $R(i)$  is obtained using Equation 1.  $D(i)$  is obtained using Equation 7.  $P(i)$  is the current vector position of the vulture.  $r_4$ ,  $r_5$ , and  $r_6$  indicate a random number for range [0, 1].  $d(t)$  represents the distance of the vulture to one of the best vultures of the two groups (Khodadadi et al., 2022).

*Exploitation 2:* Exploitation 2 enters for AVO when the  $|F|$  value is less than 0.5. Equations 15 and 16 have been used to formulate Exploitation 2 of vultures. The accumulation of several types of vultures over the food source is shown in Equations 15 and 16. Aggressive competition for food is shown in Equations 17 and 18 (Khodadadi et al., 2022).

$$P(i + 1) = \begin{cases} \text{Eq. (10)} & \text{if } P_3 \geq \text{Rand}_{P_3} \\ \text{Eq. (13)} & \text{if } P_3 < \text{Rand}_{P_3} \end{cases} \quad (14)$$

$$A_1 = \text{Vulture}_{\text{Best1}}(i) - \frac{\text{Vulture}_{\text{Best1}}(i) \times P(i)}{\text{Vulture}_{\text{Best1}}(i) \times P(i)^2} \times F$$

$$A_2 = \text{Vulture}_{\text{Best2}}(i) - \frac{\text{Vulture}_{\text{Best2}}(i) \times P(i)}{\text{Vulture}_{\text{Best2}}(i) \times P(i)^2} \times F \quad (15)$$

$$P(i + 1) = \frac{A_1 + A_2}{2} \quad (16)$$

$$P(i + 1) = R(i) - |d(t)| \times F \times \text{Levy}(d) \quad (17)$$

$$LF(x) = 0.001 \times \frac{u \times \sigma}{|v|^{\frac{1}{\beta}}}, \sigma = \left( \frac{\Gamma(1+\beta) \times \sin(\frac{\pi\beta}{2})}{\Gamma(1+\beta/2) \times \beta \times 2^{(\frac{\beta-1}{2})}} \right)^{\frac{1}{\beta}} \quad (18)$$

$\text{Vulture}_{\text{Best1}}$  is the best vulture of the first group and  $\text{Vulture}_{\text{Best2}}$  is the best vulture of the second group.  $P(i)$  is the current vector position of the vulture.  $F$  is the rate of the vulture being satiated and it is obtained using Equation 4.  $d$  represents the problem dimensions,  $u$  and  $v$  are random numbers between 0 and 1, and  $\beta$  is a fixed and default number of 1.5 (Khodadadi et al., 2022).

## EXPERIMENTAL RESULTS AND ANALYSIS

AVO is coded on Matlab. The values selected for the parameter are shown in Table 1. In the original paper of AVO,  $L_1$ ,  $L_2$ ,  $P_1$ ,  $P_2$ ,  $P_3$ , and  $w$  were suggested as 0.6, 0.4, 0.6, 0.8, 0.2, and 2.5 respectively (Khodadadi et al., 2022). In order to see the effects of parameter values on AVO, each parameter was analyzed while other parameters were used as in the original paper. As a benchmark, the average (mean) calculation was made for each function. Each parameter value was run 10 times independently. Thirteen classical test functions, which are frequently used in the literature, were selected for testing. A population size, dimension, and maximum iteration were determined as 30, 30, and 100, respectively. Table 2 shows the results of L1 parameter values, Table 3 shows the results of L2 parameter values, Table 4 shows the results of P1 parameter values, Table 5 shows the results of P2 parameter values, Table 6 shows the results of P3 parameter values, and Table 7 shows the results of  $w$  parameter values.

According to the results, the most suitable values for L1 are 0.1 and 0.6, respectively and the most suitable values for L2 are 0.9 and 0.4, respectively. According to the results for P1, the most appropriate value was determined as 0.4. According to the results for P2, the most appropriate value was determined

as 0.9. According to the results for P3, the most appropriate value was determined as 0.6. The most appropriate value for w was determined as 2.5 according to the results.

**Table 1.** The parameter values

Parameter									
<b>L<sub>1</sub></b>	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
<b>L<sub>2</sub></b>	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
<b>P<sub>1</sub></b>	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
<b>P<sub>2</sub></b>	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
<b>P<sub>3</sub></b>	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
<b>w</b>	1	1.5	2	2.5	3	3.5	4	4.5	5

**Table 2.** Analysis of L1 parameter values

<b>F</b>	<b>L<sub>1</sub>=0.9</b>	<b>L<sub>1</sub>=0.8</b>	<b>L<sub>1</sub>=0.7</b>	<b>L<sub>1</sub>=0.6</b>	<b>L<sub>1</sub>=0.5</b>	<b>L<sub>1</sub>=0.4</b>	<b>L<sub>1</sub>=0.3</b>	<b>L<sub>1</sub>=0.2</b>	<b>L<sub>1</sub>=0.1</b>
<b>F1</b>	1,37E-43	5,44E-46	1,75E-48	3,02E-42	2,12E-40	1,59E-47	2,70E-42	5,81E-42	<b>5,38E-37</b>
<b>F2</b>	5,60E-24	2,62E-24	8,18E-27	<b>1,88E-20</b>	6,39E-22	8,78E-25	5,65E-21	1,09E-21	6,90E-20
<b>F3</b>	5,26E-37	3,42E-33	4,25E-29	3,00E-31	2,20E-29	8,71E-28	3,80E-31	<b>1,21E-24</b>	5,94E-24
<b>F4</b>	1,03E-24	4,84E-24	5,99E-22	5,62E-24	5,59E-24	6,38E-21	5,78E-22	6,20E-21	<b>2,88E-19</b>
<b>F5</b>	<b>8,98E-03</b>	2,80E+00	2,19E-02	5,70E+00	1,28E-02	1,57E-02	5,59E+00	2,78E-02	2,87E+00
<b>F6</b>	3,18E-02	<b>2,43E-02</b>	1,28E-01	6,94E-02	1,26E-01	3,97E-02	6,08E-02	3,99E-02	6,10E-02
<b>F7</b>	8,99E-04	1,12E-03	9,32E-04	1,01E-03	1,45E-03	5,82E-04	1,05E-03	6,92E-04	<b>5,46E-04</b>
<b>F8</b>	-1,17E+04	-1,21E+04	-1,16E+04	<b>-1,24E+04</b>	-1,19E+04	-1,19E+04	-1,20E+04	-1,18E+04	-1,20E+04
<b>F9</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
<b>F10</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>
<b>F11</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
<b>F12</b>	1,19E-03	9,21E-04	1,56E-03	<b>4,37E-04</b>	2,80E-03	8,96E-04	1,80E-03	1,44E-03	1,59E-03
<b>F13</b>	2,23E-03	2,69E-02	2,25E-03	2,06E-02	8,38E-03	<b>3,59E-04</b>	9,17E-03	9,72E-03	8,82E-03

**Table 3.** Analysis of L2 parameter values

F	L <sub>2</sub> =0.1	L <sub>2</sub> =0.2	L <sub>2</sub> =0.3	L <sub>2</sub> =0.4	L <sub>2</sub> =0.5	L <sub>2</sub> =0.6	L <sub>2</sub> =0.7	L <sub>2</sub> =0.8	L <sub>2</sub> =0.9
<b>F1</b>	1,37E-43	5,44E-46	1,75E-48	3,02E-42	2,12E-40	1,59E-47	2,70E-42	5,81E-42	<b>5,38E-37</b>
<b>F2</b>	5,60E-24	2,62E-24	8,18E-27	<b>1,88E-20</b>	6,39E-22	8,78E-25	5,65E-21	1,09E-21	6,90E-20
<b>F3</b>	5,26E-37	3,42E-33	4,25E-29	3,00E-31	2,20E-29	8,71E-28	3,80E-31	<b>1,21E-24</b>	5,94E-24
<b>F4</b>	1,03E-24	4,84E-24	5,99E-22	5,62E-24	5,59E-24	6,38E-21	5,78E-22	6,20E-21	<b>2,88E-19</b>
<b>F5</b>	<b>8,98E-03</b>	2,80E+00	2,19E-02	5,70E+00	1,28E-02	1,57E-02	5,59E+00	2,78E-02	2,87E+00
<b>F6</b>	3,18E-02	<b>2,43E-02</b>	1,28E-01	6,94E-02	1,26E-01	3,97E-02	6,08E-02	3,99E-02	6,10E-02
<b>F7</b>	8,99E-04	1,12E-03	9,32E-04	1,01E-03	1,45E-03	5,82E-04	1,05E-03	6,92E-04	<b>5,46E-04</b>
<b>F8</b>	-1,17E+04	-1,21E+04	-1,16E+04	<b>-1,24E+04</b>	-1,19E+04	-1,19E+04	-1,20E+04	-1,18E+04	-1,20E+04
<b>F9</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
<b>F10</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>
<b>F11</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
<b>F12</b>	1,19E-03	9,21E-04	1,56E-03	<b>4,37E-04</b>	2,80E-03	8,96E-04	1,80E-03	1,44E-03	1,59E-03
<b>F13</b>	2,23E-03	2,69E-02	2,25E-03	2,06E-02	8,38E-03	<b>3,59E-04</b>	9,17E-03	9,72E-03	8,82E-03

**Table 4.** Analysis of P1 parameter values

F	P <sub>1</sub> =0.1	P <sub>1</sub> =0.2	P <sub>1</sub> =0.3	P <sub>1</sub> =0.4	P <sub>1</sub> =0.5	P <sub>1</sub> =0.6	P <sub>1</sub> =0.7	P <sub>1</sub> =0.8	P <sub>1</sub> =0.9
<b>F1</b>	1,26E-49	1,85E-49	1,74E-43	2,00E-53	<b>8,89E-56</b>	5,68E-51	7,64E-50	7,80E-45	4,62E-50
<b>F2</b>	1,08E-24	4,33E-27	1,66E-27	<b>4,42E-29</b>	7,94E-26	8,90E-27	9,29E-28	2,60E-27	9,90E-26
<b>F3</b>	2,88E-34	8,07E-37	2,81E-32	<b>1,69E-38</b>	1,98E-31	1,67E-27	7,43E-31	1,38E-31	2,74E-29
<b>F4</b>	1,15E-26	1,08E-25	1,15E-25	5,83E-25	4,01E-25	1,12E-25	1,65E-24	1,13E-24	<b>8,99E-28</b>
<b>F5</b>	6,86E-03	1,34E-02	5,28E-03	<b>5,02E-03</b>	2,77E+00	3,04E-02	1,58E-02	1,13E+01	1,67E+01
<b>F6</b>	2,09E-02	2,12E-02	4,87E-02	<b>1,81E-02</b>	1,65E-01	6,57E-02	1,63E-01	9,03E-02	7,33E-02
<b>F7</b>	8,18E-04	1,10E-03	1,57E-03	6,82E-04	5,57E-04	<b>5,54E-04</b>	1,22E-03	6,50E-04	1,45E-03
<b>F8</b>	-1,08E+04	-1,19E+04	-1,18E+04	-1,16E+04	-1,13E+04	-1,20E+04	<b>-1,22E+04</b>	-1,21E+04	-1,13E+04
<b>F9</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
<b>F10</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>
<b>F11</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
<b>F12</b>	9,36E-04	1,72E-04	7,55E-04	1,03E-03	4,79E-04	<b>1,65E-04</b>	3,23E-03	6,13E-04	2,17E-03
<b>F13</b>	1,52E-04	1,66E-04	1,07E-04	<b>2,09E-05</b>	9,15E-03	9,42E-03	1,72E-02	1,29E-02	2,20E-01

**Table 5.** Analysis of P2 parameter values

F	P <sub>2</sub> =0.1	P <sub>2</sub> =0.2	P <sub>2</sub> =0.3	P <sub>2</sub> =0.4	P <sub>2</sub> =0.5	P <sub>2</sub> =0.6	P <sub>2</sub> =0.7	P <sub>2</sub> =0.8	P <sub>2</sub> =0.9
F1	2,69E-39	1,91E-37	3,50E-47	1,86E-47	1,26E-55	<b>2,16E-61</b>	8,53E-61	3,62E-60	3,57E-59
F2	4,97E-25	3,04E-24	1,77E-27	2,40E-27	1,97E-27	1,77E-30	6,69E-25	3,41E-27	<b>9,57E-33</b>
F3	7,03E-23	8,39E-26	4,12E-24	1,26E-34	4,63E-36	1,54E-37	8,04E-36	6,96E-45	<b>1,91E-45</b>
F4	1,05E-19	2,33E-23	2,18E-22	1,65E-28	1,99E-26	3,45E-29	2,01E-30	<b>4,21E-31</b>	8,79E-28
F5	1,20E-01	5,64E+00	4,15E-02	3,41E-02	2,81E+00	2,84E+00	1,84E-02	2,88E+00	<b>8,55E-03</b>
F6	5,32E-02	1,21E-01	2,14E-02	2,41E-02	<b>1,10E-02</b>	6,42E-02	2,86E-02	4,39E-02	4,72E-02
F7	1,04E-03	1,17E-03	5,59E-04	8,32E-04	1,08E-03	<b>5,34E-04</b>	1,23E-03	1,32E-03	7,94E-04
F8	-1,23E+04	<b>-1,24E+04</b>	-1,21E+04	-1,22E+04	- <b>1,24E+04</b>	- 1,20E+04	- 1,18E+04	- 1,19E+04	- 1,21E+04
F9	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
F10	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>
F11	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
F12	<b>8,91E-04</b>	1,39E-03	1,34E-03	2,35E-03	4,04E-03	3,08E-03	9,20E-04	2,16E-03	1,66E-03
F13	1,06E-02	4,99E-03	7,72E-04	2,29E-02	8,48E-03	8,24E-03	1,95E-05	<b>1,91E-05</b>	2,16E-05

**Table 6.** Analysis of P3 parameter values

F	P <sub>3</sub> =0.1	P <sub>3</sub> =0.2	P <sub>3</sub> =0.3	P <sub>3</sub> =0.4	P <sub>3</sub> =0.5	P <sub>3</sub> =0.6	P <sub>3</sub> =0.7	P <sub>3</sub> =0.8	P <sub>3</sub> =0.9
F1	3,33E-30	9,10E-41	1,26E-36	9,75E-53	<b>4,87E-55</b>	7,07E-39	6,17E-48	3,18E-53	6,01E-48
F2	1,70E-22	3,04E-19	4,61E-22	3,40E-24	1,45E-24	<b>1,09E-28</b>	8,13E-28	7,77E-26	1,59E-26
F3	1,35E-08	3,07E-22	2,01E-26	6,26E-32	4,79E-25	1,38E-30	4,22E-32	1,34E-28	<b>9,76E-39</b>
F4	4,19E-13	6,18E-23	2,33E-20	1,82E-23	9,45E-27	3,74E-26	<b>2,24E-27</b>	7,60E-27	2,52E-24
F5	1,69E+01	5,59E+00	1,69E+01	8,39E+00	2,89E+00	<b>1,17E-02</b>	2,79E+00	5,66E+00	5,56E+00
F6	3,25E-01	2,56E-01	9,72E-02	6,62E-02	4,40E-02	7,32E-02	5,98E-02	<b>2,07E-02</b>	2,47E-02
F7	9,50E-04	7,95E-04	1,80E-03	9,14E-04	1,42E-03	<b>6,00E-04</b>	1,01E-03	6,43E-04	9,32E-04
F8	-1,17E+04	<b>-1,24E+04</b>	-1,08E+04	-1,20E+04	- 1,22E+04	- 1,12E+04	- 1,18E+04	- 1,17E+04	- <b>1,24E+04</b>
F9	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
F10	1,24E-15	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>
F11	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
F12	2,69E-03	4,03E-03	3,55E-03	1,03E-03	5,09E-03	3,27E-03	2,31E-03	<b>1,40E-04</b>	2,39E-03
F13	5,20E-02	2,34E-02	7,48E-02	1,83E-03	2,17E-02	2,32E-04	<b>5,92E-05</b>	6,45E-04	7,55E-03

**Table 7.** Analysis of w parameter values

F	w=1	w=1.5	w=2	w=2.5	w=3	w=3.5	w=4	w=4.5	w=5
<b>F1</b>	1,14E-40	1,33E-44	1,49E-43	<b>3,20E-52</b>	1,03E-48	2,03E-50	9,96E-44	1,88E-49	2,39E-50
<b>F2</b>	3,21E-23	1,05E-25	7,74E-24	1,20E-24	<b>1,86E-27</b>	4,07E-26	8,76E-23	5,54E-25	4,45E-27
<b>F3</b>	7,00E-34	1,72E-24	2,93E-33	5,01E-30	8,15E-31	<b>2,68E-34</b>	1,60E-22	4,86E-27	1,79E-28
<b>F4</b>	6,88E-24	3,58E-20	2,09E-23	<b>7,42E-27</b>	1,15E-25	8,67E-23	2,70E-26	1,88E-26	1,72E-26
<b>F5</b>	5,62E+00	9,19E-03	1,91E-02	5,65E+00	<b>4,05E-03</b>	9,01E-03	1,08E-02	2,78E+00	5,53E+00
<b>F6</b>	4,47E-02	2,64E-02	9,78E-02	3,54E-02	<b>7,76E-03</b>	8,09E-02	4,12E-02	7,09E-02	2,94E-02
<b>F7</b>	9,43E-04	1,16E-03	8,88E-04	8,03E-04	8,06E-04	7,62E-04	1,10E-03	8,87E-04	<b>5,47E-04</b>
<b>F8</b>	-1,22E+04	-1,20E+04	-1,18E+04	<b>-1,24E+04</b>	- 1,17E+04	- 1,21E+04	- 1,18E+04	- 1,20E+04	- 1,23E+04
<b>F9</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
<b>F10</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>	<b>8,88E-16</b>
<b>F11</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>	<b>0,00E+00</b>
<b>F12</b>	8,85E-04	8,25E-04	1,53E-03	<b>4,95E-05</b>	1,50E-03	2,23E-03	2,49E-03	1,37E-03	1,58E-03
<b>F13</b>	1,02E-02	3,46E-03	3,74E-03	2,91E-03	1,50E-03	<b>7,37E-05</b>	4,27E-03	3,45E-03	3,64E-03

## CONCLUSIONS

In this study, the newly proposed AVO algorithm in recent years has been examined. Six kinds of parameters that balance local and global search capabilities are used in the AVO algorithm. The effect of these parameters on AVO results is analyzed in detail in this paper. These parameters are:  $L1=\{0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2, 0.1\}$ ,  $L2=\{0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9\}$ ,  $P1=\{0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9\}$ ,  $P2=\{0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9\}$ ,  $P3=\{0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9\}$ ,  $w = \{1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5\}$ . Their performance on thirteen classical test functions was evaluated. According to the results, the most suitable values for L1 are 0.1 and 0.6, respectively and the most suitable values for L2 are 0.9 and 0.4, respectively. According to the results for P1, the most appropriate value was determined as 0.4. According to the results for P2, the most appropriate value was determined as 0.9. According to the results for P3, the most appropriate value was determined as 0.6. The most appropriate value for w was determined as 2.5 according to the results.

Although L1, L2, P1, P2, P3, and w in the original article of AVO were suggested as 0.6, 0.4, 0.6, 0.8, 0.2, and 2.5, respectively, according to the results of this paper, they were determined as 0.6, 0.4, 0.4, 0.9, 0.6, and 2.5, respectively.

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## **BINARY AFRICAN VULTURES OPTIMIZATION ALGORITHM FOR Z-SHAPED TRANSFER FUNCTIONS**

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### **ABSTRACT**

Metaheuristic algorithms are of great importance in solving binary optimization problems. African Vulture Optimization algorithm (AVO) is a swarm intelligence-based heuristic algorithm created by imitating the life forms of African vultures. In this study, the AVO, which has been proposed in recent years, is restructured to solve binary optimization problems. Thus, Binary AVO (BAVO) has been proposed. Four different z-shaped transfer functions are chosen to convert the continuous search space to binary search space. Variations for BAVO are defined according to the transfer function used (BAVO1, BAVO2, BAVO3, and BAVO4). The success of these variations was tested in thirteen classic test functions containing unimodal and multimodal functions. Three different dimensions were determined in the study (5, 10, and 20). Each test function was run ten times independently and the average, standard deviation, best, and worst values were obtained. According to the results obtained, the most successful of these variations has been identified. According to the results, the BAVO4 variant at higher dimensions achieved better results. The success of BAVO with z-shaped transfer functions was demonstrated for the first time in this study.

**Keywords:** African vultures, Z-shaped transfer functions, BAVO

### **INTRODUCTION**

In real-world problems, the search space does not always consist of continuous variables. Sometimes it can also consist of values that contain discrete values. Therefore, metaheuristic algorithms should be structured to solve not only continuous problems but also discrete problems. In discrete optimization, variables in the search space can consist of integers as well as binary values. Many different problems can be solved by using these binary values in the search space (feature selection, facility layout problem with no capacity, etc.). Such problems are called binary optimization problems. A heuristic algorithm that solves many binary optimization problems has been proposed in the literature. Al-Tashi et al. solved the feature selection problems with Hybrid Grey Wolf Optimization (Al-Tashi et al., 2019). They used 18 standard benchmark datasets and they preferred K-Nearest Neighbors (KNN) as the classifier. Baykasoğlu et al. proposed a weighted superposition attraction algorithm for binary optimization problems (Baykasoğlu et al., 2020). They selected three well-known binary optimization problems, including the uncapacitated facility location problem, 0–1 knapsack problem, and a natural extension of it, the set union knapsack problem. Baş proposed a Binary Aquila Optimizer for 0–1 knapsack problems (Baş, 2023).

In recent years, the newly proposed African Vulture Optimization (AVO) algorithm is a heuristic algorithm created by mathematically modeling the lifestyles of African vultures. In recent years, many studies have been done with AVO. Khodadadi et al. proposed a new multi-objective artificial vultures optimization algorithm (Khodadadi et al., 2022). Alanazi et al. proposed an optimal reconfiguration of a shaded PV-based system using the African vultures optimization approach (Alanazi et al., 2022). Xiao et al. proposed an improved hybrid Aquila Optimizer and African vultures optimization algorithm for global optimization problems (Xiao et al., 2022). Kumar and Mary proposed a study about parameter estimation of a three-diode solar photovoltaic model using an Improved-African Vultures optimization algorithm with the Newton–Raphson method (Kumar and Mary, 2021). Xi et al. proposed a Binary African vultures optimization algorithm for various optimization problems (Xi et al., 2022).

In this study, Binary AVO (BAVO) is proposed by converting the continuous search space of AVO to binary search space. During the translation into binary search space, four different z-shaped transfer functions are used (Guo et al., 2020). According to these transfer functions, four different BAVO variations were created. These are BAVO1, BAVO2, BAVO3, and BAVO4. The success of BAVO according to z-shaped transfer functions is shown for the first time in this paper. In this respect, the paper offers innovation. The success of the BAVO is demonstrated on 13 unimodal and multi-modal test functions.

### **AFRICAN VULTURES OPTIMIZATION ALGORITHM**

Vultures fall into two main categories. These are the new world vultures and the old world vultures. New-world vultures are found in America, while old-world vultures live in Europe, Asia, and Africa. The body of most vultures is not completely covered with feathers. There are no feathers on the neck and head. They feed on animal leaves. They don't nest. The basic principles of AVO to model AVO mathematically: (Khodadadi et al., 2022)

There are at most N (population numbers) vultures in a search space.

- The total number of vultures is divided into two main groups. In AVO, the fitness solutions of the whole population are first calculated. The first two best solutions are chosen and the first two vultures are determined. The remaining population members form a population that moves or replaces one of the two best vultures at each performance (Khodadadi et al., 2022).
- In AVO, the worst vulture is the weakest and most hungry vulture. Other vultures try to stay away from him. The best and strongest vulture are the first two vultures. Population members try to best approach the first two vultures (Khodadadi et al., 2022).

AVO is mathematically modeled in four steps.

#### **First scene:**

After the initial population is established, the fitness of all solutions is calculated and the best solution is chosen as the best vulture of the first group and the second best solution as the best vulture of the second group. Other population members try to move best toward the first two vultures. In each cycle, the fitness values are reapplied for the entire population. The work of approximating the best first two solutions of the other groups is calculated by Equation 1 (Khodadadi et al., 2022).

$$R(i) = \begin{cases} Vulture_{Best1} & \text{if } P_i = L_1 \\ Vulture_{Best2} & \text{if } P_i = L_2 \end{cases} \quad (1)$$

$$\text{Subject: } L_1 + L_2 = 1$$

$$P_i = \frac{F_i}{\sum_{i=1}^n F_i} \quad (2)$$

The probability of choosing one of the two best solutions is obtained by Equation 2 (Khodadadi et al., 2022).  $Vulture_{Best1}$  is the first best vulture of the group and  $Vulture_{Best2}$  is the second-best vulture of the group.

#### **Second scene:**

Equations 3-4 were used to move from the exploration stage to the exploitation stage, inspired by the saturation or hunger rates of the vultures. Vultures often forage for food but fly longer distances if they are full. If a vulture is hungry, they don't have enough energy to fly for long periods and forage for food near the stronger vulture (Khodadadi et al., 2022). According to the  $|F|$  value, it moves to the third scene or fourth scene. If  $|F|$  value less than 1, AVO enters the exploration stage, otherwise, AVO enters the

exploitation stage (Khodadadi et al., 2022).

$$t = h \times \left( \sin^w \left( \frac{\pi}{2} \times \frac{iter_i}{Max\_iter} \right) + \cos \left( \frac{\pi}{2} \times \frac{iter_i}{Max\_iter} \right) - 1 \right) \quad (3)$$

$$F = (2 \times r_1 + 1) \times z \times \left( 1 - \frac{iter_i}{Max\_iter} \right) + 1 \quad (4)$$

$F$  indicates that the vultures are satiated.  $iter_i$  shows the current iteration number,  $Max\_iter$  shows the maximum iteration number,  $z$  indicates a random number for range  $[-1, 1]$ ,  $h$  indicates a random number for range  $[-2, 2]$ , and  $r_1$  indicates a random number for range  $[0, 1]$  (Khodadadi et al., 2022).

### **Third scene:** The Exploration

At this stage, the discovery phase of AVOA is modeled. In the natural environment, vultures have high visual acuity and the ability to find food and spot poor dying animals. But finding food for vultures can be very difficult. Vultures carefully study their environment for a long time and travel long distances in search of food.

In AVO, vultures explore the search space based on two different situations. Here, the selection process for both states is made according to P1. The discovery process in AVO is shown in Equations 5-8 (Khodadadi et al., 2022).

$$P(i + 1) = \begin{cases} Eq. (6) & \text{if } P_1 \geq Rand_{P1} \\ Eq. (8) & \text{if } P_1 < Rand_{P1} \end{cases} \quad (5)$$

$$P(i + 1) = R(i) - D(i) \times F \quad (6)$$

$$D(i) = |X \times R(i) - P(i)| \quad (7)$$

$$P(i + 1) = R(i) - F + r_2 \times ((ub - lb) \times r_3 + lb) \quad (8)$$

$F$  is the rate of the vulture being satiated and it is obtained using Equation 4.  $R(i)$  is obtained using Equation 1.  $X$  is a coefficient vector ( $X = rand \times 2$ ;  $rand$  indicates a random number for range  $[0, 1]$ ).  $P(i)$  is the current vector position of the vulture.  $r_2$  and  $r_3$  indicate a random number for range  $[0, 1]$ .  $ub$  and  $lb$  indicate upper and lower bounds (Khodadadi et al., 2022).

### **Fourth scene:** The exploitation

In this subsection, local search operations are continued according to P2 and P3 values.

*Exploitation 1:* Exploitation 1 enters for AVO when the  $|F|$  value is between 1 and 0.5. Competition for Food is shown in Equations 10 and 11. The rotating flight of vultures is shown in Equations 12 and 13 (Khodadadi et al., 2022).

$$P(i + 1) = \begin{cases} Eq. (10) & \text{if } P_2 \geq Rand_{P2} \\ Eq. (13) & \text{if } P_2 < Rand_{P2} \end{cases} \quad (9)$$

$$P(i + 1) = D(i) \times F + (r_4) - d(t) \quad (10)$$

$$d(t) = R(i) - P(i) \quad (11)$$

$$S_1 = R(i) \times \left( \frac{r_5 \times P(i)}{2\pi} \right) \times \cos(P(i)) \quad (12)$$

$$S_2 = R(i) \times \left( \frac{r_6 \times P(i)}{2\pi} \right) \times \sin(P(i))$$

$$P(i + 1) = R(i) - (S_1 + S_2) \quad (13)$$

$F$  is the rate of the vulture being satiated and it is obtained using Equation 4.  $R(i)$  is obtained using Equation 1.  $D(i)$  is obtained using Equation 7.  $P(i)$  is the current vector position of the vulture.  $r_4$ ,  $r_5$ , and  $r_6$  indicate a random number for range [0, 1].  $d(t)$  represents the distance of the vulture to one of the best vultures of the two groups (Khodadadi et al., 2022).

*Exploitation 2:* Exploitation 2 enters for AVO when the  $|F|$  value is less than 0.5. Equations 15 and 16 have been used to formulate Exploitation 2 of vultures. The accumulation of several types of vultures over the food source is shown in Equations 15 and 16. Aggressive competition for food is shown in Equations 17 and 18 (Khodadadi et al., 2022).

$$P(i + 1) = \begin{cases} \text{Eq. (10)} & \text{if } P_3 \geq \text{Rand}_{P_3} \\ \text{Eq. (13)} & \text{if } P_3 < \text{Rand}_{P_3} \end{cases} \quad (14)$$

$$A_1 = \text{Vulture}_{Best1}(i) - \frac{\text{Vulture}_{Best1}(i) \times P(i)}{\text{Vulture}_{Best1}(i) \times P(i)^2} \times F$$

$$A_2 = \text{Vulture}_{Best2}(i) - \frac{\text{Vulture}_{Best2}(i) \times P(i)}{\text{Vulture}_{Best2}(i) \times P(i)^2} \times F \quad (15)$$

$$P(i + 1) = \frac{A_1 + A_2}{2} \quad (16)$$

$$P(i + 1) = R(i) - |d(t)| \times F \times \text{Levy}(d) \quad (17)$$

$$LF(x) = 0.001 \times \frac{u \times \sigma}{|v|^{\frac{1}{\beta}}}, \sigma = \left( \frac{\Gamma(1+\beta) \times \sin(\frac{\pi\beta}{2})}{\Gamma(1+\beta/2) \times \beta \times 2^{(\frac{\beta-1}{2})}} \right)^{\frac{1}{\beta}} \quad (18)$$

$\text{Vulture}_{Best1}$  is the best vulture of the first group and  $\text{Vulture}_{Best2}$  is the best vulture of the second group.  $P(i)$  is the current vector position of the vulture.  $F$  is the rate of the vulture being satiated and it is obtained using Equation 4.  $d$  represents the problem dimensions,  $u$  and  $v$  are random numbers between 0 and 1, and  $\beta$  is a fixed and default number of 1.5 (Khodadadi et al., 2022).

## BINARY AFRICAN VULTURES OPTIMIZATION ALGORITHM

Four different z-shaped transfer functions are preferred in this study in converting the continuous search space to binary search space. A binary AVO (BAVO) variation was generated for each transfer function. These are named BAVO1, BAVO2, BAVO3, and BAVO4. The z-shaped transfer functions used in the study are shown in Table 1.

**Table 1.** Z-shaped transfer functions (Guo et al., 2020)

Variations of BAVO	Name	Expression
BAVO1	Z1	$z1(x) = \sqrt{1 - 2^x}$
BAVO2	Z2	$z1(x) = \sqrt{1 - 5^x}$
BAVO3	Z3	$z1(x) = \sqrt{1 - 8^x}$
BAVO4	Z4	$z1(x) = \sqrt{1 - 20^x}$

While the continuous search space of AVO was converted to binary search space, the size of each population individual was calculated as in Equation 19. In this study, thirteen classical test functions in three different dimensions (5, 10, 20) were tested. According to these dimensions, the size of each population individual was adjusted as 500, 1000, and 1500 for dimensions 5, 10, and 20, respectively (Equation 19). The parameter of the Z transfer function is set as 2, 5, 8, and 20 (Guo et al., 2020).

$$Dimension_{population\ individual} = Dimension_{Function} \times 50 \quad (19)$$

## EXPERIMENTAL RESULTS AND ANALYSIS

BAVO is coded on Matlab R2014a. The values of the parameter are shown in Table 1. These parameter settings were examined by Baş and BAVO was run with the values determined by her. Classic 13 unimodal and multimodal test functions were selected to test the success of BAVO. Each function was run in three different dimensions (5, 10, and 20). each function was run independently ten times. Four different comparison procedures were applied to the results obtained. These are mean (Ave), standard deviation (StdS), best, and worst values. AVO is translated into binary space with four different Z-shaped transfer functions. The variants of the BAVO were obtained for each transfer function. These are BAVO1, BAVO2, BAVO3, and BAVO4. The results obtained are shown in Tables 3-8. The best results are marked in bold.

When examining the best and average results for sizes 10 and 20, it was observed that BAVO4 was more successful than the other BAVO variants. Examining the average results according to dimension 5, BAVO3 achieved the best results. When examining the best results, BAVO1 and BAVO2 showed superior performance.

**Table 2.** The parameter values

Methods	Population size (N)	Maximum Iteration	Run	Dimension (D)	P1	P2	P3	L1	L2	w
<b>BAVO</b>	30	1000	10	5, 10, 20	0.6	0.4	0.4	0.9	0.6	2.5

**Table 3.** BAVO test results for D=5

F	BAVO1		BAVO2		BAVO3		BAVO4	
	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>
<b>F1</b>	<b>0,00</b>	698,00	<b>0,00</b>	2,88	<b>0,00</b>	0,15	<b>0,00</b>	0,00
<b>F2</b>	<b>0,00</b>	3,26	<b>0,00</b>	0,27	<b>0,00</b>	0,03	<b>0,00</b>	0,02
<b>F3</b>	413,18	2916,69	22,52	3282,17	<b>11,83</b>	3311,46	720,76	2968,75
<b>F4</b>	<b>0,00</b>	15,32	<b>0,00</b>	3,12	0,10	7,84	<b>0,00</b>	3,38
<b>F5</b>	<b>3,47</b>	26938,72	4,06	13465,14	3,90	11570,78	3,95	54141,73
<b>F6</b>	5,58	660,96	<b>0,06</b>	54,87	0,37	33,52	1,01	611,37
<b>F7</b>	0,01	0,13	<b>0,00</b>	0,10	<b>0,00</b>	0,05	<b>0,00</b>	0,07
<b>F8</b>	-1922,32	-1011,52	-1749,09	-902,95	<b>-2040,13</b>	-902,95	-1674,25	-902,95
<b>F9</b>	<b>0,00</b>	18,47	0,10	19,69	<b>0,00</b>	12,08	<b>0,00</b>	13,83
<b>F10</b>	1,71	6,64	<b>0,00</b>	1,71	0,05	2,82	<b>0,00</b>	2,38
<b>F11</b>	<b>0,00</b>	1,64	0,05	0,65	0,05	0,51	0,07	0,58
<b>F12</b>	<b>0,13</b>	22,04	1,00	7,03	0,24	24,75	0,29	13,27
<b>F13</b>	0,48	254,81	<b>0,29</b>	1,26	0,39	1,04	0,50	1,65

**Table 4.** BAVO test results for D=5

F	BAVO1		BAVO2		BAVO3		BAVO4	
	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>
<b>F1</b>	157,16	202,83	0,33	0,85	0,02	0,05	<b>0,00</b>	0,00
<b>F2</b>	1,53	1,19	0,08	0,08	0,01	0,01	<b>0,00</b>	0,01
<b>F3</b>	<b>1270,59</b>	862,69	1364,40	1063,37	1289,17	1133,30	1669,12	593,48
<b>F4</b>	7,47	4,68	1,13	0,88	2,26	2,59	<b>1,07</b>	1,17
<b>F5</b>	6159,57	8847,24	2562,02	4171,19	<b>2418,52</b>	3625,01	5822,95	16114,07
<b>F6</b>	117,91	189,67	11,34	16,33	<b>5,23</b>	9,73	84,01	179,94
<b>F7</b>	0,04	0,03	0,03	0,02	<b>0,02</b>	0,01	<b>0,02</b>	0,02
<b>F8</b>	<b>-1571,95</b>	245,49	-1419,35	277,12	-1222,09	359,08	-1242,43	215,43
<b>F9</b>	7,27	6,15	5,47	5,81	<b>4,43</b>	4,02	4,86	4,57
<b>F10</b>	4,19	1,93	<b>0,73</b>	0,73	1,40	1,02	0,97	1,12
<b>F11</b>	0,97	0,57	0,34	0,16	<b>0,30</b>	0,16	<b>0,30</b>	0,16
<b>F12</b>	8,38	7,68	<b>3,37</b>	2,12	6,75	6,79	4,07	3,57
<b>F13</b>	54,31	96,55	0,68	0,25	<b>0,66</b>	0,19	0,87	0,39

**Table 5. BAVO test results for D=10**

F	BAVO1		BAVO2		BAVO3		BAVO4	
	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>
<b>F1</b>	604,77	5465,14	0,58	321,12	0,05	43,54	<b>0,01</b>	0,78
<b>F2</b>	5,11	15,46	0,64	2,87	0,03	1,44	<b>0,00</b>	0,40
<b>F3</b>	3995,19	14372,24	<b>2372,28</b>	10902,85	3176,54	11635,57	2546,28	12260,42
<b>F4</b>	24,22	54,31	10,74	28,45	<b>2,48</b>	23,37	3,02	25,86
<b>F5</b>	66070,77	2146342,49	300,79	42306,53	50,22	292406,33	<b>21,18</b>	117450,86
<b>F6</b>	1259,89	6251,35	<b>2,23</b>	686,95	5,20	2514,51	3,02	1377,91
<b>F7</b>	0,31	1,62	0,03	0,26	<b>0,02</b>	0,28	<b>0,02</b>	0,13
<b>F8</b>	-2460,90	-1805,89	<b>-3001,20</b>	-1805,89	-2997,02	-1805,89	-2964,10	-1805,89
<b>F9</b>	21,83	73,87	7,91	31,66	<b>1,24</b>	33,93	11,16	28,08
<b>F10</b>	7,08	17,86	1,44	8,35	1,53	4,08	<b>0,51</b>	5,09
<b>F11</b>	2,00	29,02	<b>0,14</b>	2,90	0,42	9,54	0,19	1,07
<b>F12</b>	24818,90	5695383,77	1,99	21,09	<b>1,42</b>	93,90	1,48	12,97
<b>F13</b>	316766,28	13608806,55	1,91	434,24	1,19	5,15	<b>1,01</b>	3,14

**Table 6. BAVO test results for D=10**

F	BAVO1		BAVO2		BAVO3		BAVO4	
	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>
<b>F1</b>	2412,23	1570,16	55,13	94,02	7,97	12,17	<b>0,20</b>	0,22
<b>F2</b>	11,15	3,51	1,75	0,66	0,61	0,51	<b>0,05</b>	0,12
<b>F3</b>	10235,34	2871,42	6531,42	3174,41	<b>5824,50</b>	2368,42	6458,33	3124,10
<b>F4</b>	38,62	10,75	18,28	5,42	<b>13,75</b>	7,25	14,25	7,69
<b>F5</b>	887408,36	621862,67	<b>11268,60</b>	14158,60	61161,57	99480,21	26683,17	36090,12
<b>F6</b>	2866,24	1477,70	<b>229,89</b>	224,33	468,45	756,45	408,20	517,11
<b>F7</b>	0,92	0,34	0,12	0,06	0,11	0,08	<b>0,06</b>	0,04
<b>F8</b>	<b>-2043,73</b>	274,68	-1925,42	358,59	-2018,99	429,89	-1921,71	347,46
<b>F9</b>	48,08	18,06	16,92	6,63	<b>15,43</b>	8,70	17,77	5,19
<b>F10</b>	14,02	2,88	4,72	2,09	<b>2,35</b>	0,71	2,90	1,27
<b>F11</b>	16,47	8,58	1,27	0,83	1,63	2,65	<b>0,54</b>	0,31
<b>F12</b>	1248636,04	1651782,00	11,66	5,00	19,19	25,32	<b>6,10</b>	3,22
<b>F13</b>	5210318,13	4972351,95	46,15	129,37	2,66	1,08	<b>1,59</b>	0,59



**Table 7. BAVO test results for D=20**

F	BAVO1		BAVO2		BAVO3		BAVO4	
	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>	<i>Best</i>	<i>Worst</i>
<b>F1</b>	11797,29	24028,17	645,74	2752,72	151,07	2091,86	<b>45,82</b>	2749,59
<b>F2</b>	36,67	96,32	5,30	24,38	2,33	8,32	<b>0,40</b>	9,23
<b>F3</b>	24955,16	64526,99	21252,97	42574,31	18460,80	42716,79	<b>14227,50</b>	34433,87
<b>F4</b>	55,82	68,29	39,78	51,11	<b>25,52</b>	46,29	27,53	44,07
<b>F5</b>	10319310,99	76765001,56	41482,77	2081374,93	15900,42	7358618,94	<b>11191,71</b>	10436240,76
<b>F6</b>	6559,89	21293,05	1204,50	6679,43	174,13	5939,68	<b>62,61</b>	10181,40
<b>F7</b>	10,36	23,79	0,28	3,65	0,29	1,22	<b>0,21</b>	0,74
<b>F8</b>	-4258,02	-3611,78	-3611,78	-3611,78	<b>-3719,16</b>	-3611,78	-3611,78	-3611,78
<b>F9</b>	148,40	224,08	63,85	159,17	35,46	81,47	<b>31,24</b>	59,10
<b>F10</b>	15,75	19,94	9,71	19,94	5,30	13,56	<b>3,80</b>	12,08
<b>F11</b>	63,90	193,77	6,16	21,63	2,01	16,85	<b>1,27</b>	15,78
<b>F12</b>	6358102,64	91823215,14	10,79	165738,82	8,05	5901,36	<b>5,21</b>	28401,01
<b>F13</b>	62626129,81	207552420,20	2079,58	4385953,92	15,55	682972,60	<b>4,48</b>	12,36

**Table 8. BAVO test results for D=20**

F	BAVO1		BAVO2		BAVO3		BAVO4	
	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>	<i>Ave</i>	<i>StdS</i>
<b>F1</b>	16464,80	3928,72	1347,21	697,94	603,78	596,03	<b>575,72</b>	794,99
<b>F2</b>	51,57	18,73	15,37	5,82	5,13	1,87	<b>3,66</b>	2,87
<b>F3</b>	45138,26	13059,88	31634,28	6709,76	28125,77	8034,91	<b>24185,97</b>	7298,53
<b>F4</b>	64,82	3,87	45,76	3,69	38,69	5,56	<b>34,87</b>	5,39
<b>F5</b>	39772034,89	18243594,45	864427,27	645499,28	1448154,04	2643848,57	<b>1767088,22</b>	3532710,46
<b>F6</b>	15143,47	4469,15	2675,30	1809,85	<b>1536,86</b>	1546,64	2955,95	2779,37
<b>F7</b>	14,77	4,08	1,72	1,07	0,79	0,34	<b>0,42</b>	0,15
<b>F8</b>	<b>-3676,41</b>	193,87	-3611,78	0,00	-3622,52	32,21	-3611,78	0,00
<b>F9</b>	190,69	22,63	97,36	26,37	62,02	11,57	<b>46,01</b>	9,39
<b>F10</b>	19,37	1,28	15,11	3,95	9,90	3,02	<b>7,91</b>	2,82
<b>F11</b>	153,65	38,12	13,45	4,26	6,49	4,26	<b>3,68</b>	4,12
<b>F12</b>	42510032,05	27377666,54	43218,66	53999,04	<b>1735,43</b>	2313,87	3619,43	8513,82
<b>F13</b>	135692513,79	51627993,33	962904,73	1353056,71	92209,82	202019,41	<b>8,08</b>	2,32

## CONCLUSIONS

In this study, AVO, one of the recently proposed heuristic algorithms, has been examined. AVO was originally proposed as an algorithm for solving continuous optimization problems. In this study, AVO is restructured to solve binary optimization problems. Although there are many transfer functions in the literature that converts continuous search space to binary search space (S-shaped, V-shaped, etc.), newly proposed Z-shaped transfer functions have been selected in this study. Thus, binary versions of BAVO are structured according to Z-shaped transfer functions for the first time in this study. Four different BAVO variants (BAVO1, BAVO2, BAVO3, BAVO4) were tested on 13 classical unimodal and multimodal test functions with success in three different dimensions (5, 10, 20). The best, worst, mean, and standard deviation calculations were made on the results and the results were compared in a detailed way. According to the results, the BAVO4 variant at higher dimensions achieved better results.

In future studies, it is considered to test the success of the BAVO4 variant in different binary optimization problems.

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## EVALUATION OF TWIST, E-CADHERIN AND INTEGRIN-B-1 EXPRESSION IN ORTHOKERATINIZED ODONTOGENIC KERATOCYST AND KERATOCYSTIC ODONTOGENIC TUMORS

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### INTRODUCTION

Loss of adhesion, polarization and increased cell motility in epithelial cells as a result of dysregulation of the epithelial-mesenchymal transition is considered as a potential mechanism for tumors to become invasive. Recent studies further demonstrate that EMF is important not only in tumor invasion, but also in tumor recurrence and biology (1, 2). A number of transcription factors play a major role in the formation of the epithelial-mesenchymal transition. The most important known factors are ZEB 1 and ZEB 2, snail, slug and twist (3, 4, 5). Zinc finger transcription factors snail, slug, twist, ZEB1, SIP1, and E47 play an important role in activating e-cadherin during epithelial-mesenchymal transition. In addition, TGF $\beta$ , Wnt, NF- $\kappa$ B, notch, integrins and EGF, FGF, HGF, PDGF, IGF from the tyrosine kinase receptor family play a role in epithelial-mesenchymal transition (6, 7, 8). Semi-keratinizing (parakeratin) odontogenic keratocyst among developing cysts is the cyst with the highest development and recurrence potential among all odontogenic cysts, and in the classification defined by the World Health Organization (DST) in 2005, semi-keratinizing (parakeratin) type odontogenic keratocyst was removed from the cyst classification as "It is included in the class of odontogenic tumors under the name "Keratocystic Odontogenic Tumor" (KOS). Odontogenic keratocyst of orthokeratotic type is included in the classification of odontogenic cyst as "odontogenic cyst of orthokeratosis type". However, the debate on this classification issue is still ongoing and a unanimous opinion has not yet been established among different groups. There are researchers who argue that it is important to keep this nucleus in the cyst classification due to its morphologically cystic structure and the main biological behavior of the semikeratinized (parakeratin) type odontogenic keratocyst (9,10, 11). Our main goal in this work is integrin  $\beta$ -1 in keratocystic odontogenic tumors and orthokeratotic type odontogenic keratocysts; is to evaluate the expression of twist and e-cadherin. Based on the obtained data, the possible roles of epithelial-mesenchymal transition indicators in the biological behavior and pathogenesis of odontogenic tumors will be discussed. The histopathological symptoms and clinical behavior of OCC developing odontogenic cysts should be evaluated specifically. It is mostly observed in the second and third decades. Histologically, there are 2 subtypes: parakeratotic and orthokeratotic. In the classification defined by the World Health Organization (DST) in 2005, semikeratinized (parakeratin) type odontogenic keratocyst was removed from the cyst classification and included in the class of odontogenic tumors under the name "Keratocystic Odontogenic Tumor" (KOS). Odontogenic keratocyst of orthokeratotic type is included in the classification of odontogenic cyst as "odontogenic cyst of orthokeratosis type". However, the debate on this classification issue is still ongoing and a unanimous opinion has not yet been established among different groups. There are researchers who argue that it is important to keep this nucleus in the cyst classification due to its morphologically cystic structure and the main biological behavior of the semikeratinizing (parakeratin) type odontogenic keratocyst (9,10, 11).

### MATERIAL AND METHODS

31 of the 49 cases included in the study were keratocystic odontogenic tumor (KOS); 8 were odontogenic keratocysts (OCK) showing orthokeratinization. As a control group, 10 pieces of dental follicle tissue (DF) were included in the work. All hematoxylin & eosin-stained sections of the cases were reanalyzed. The cases were divided into groups according to histological subtypes, and the paraffin blocks to be used in the preparation of sections for immunohistochemical method were determined.

Histopathological evaluation was performed under an Olympus BX-51 (Olympus Microsystems America. Inc) light microscope. Clinical data such as gender, age, and location of all cases were recorded. In cases of odontogenic keratocyst, the type of keratinization (keratinization) was evaluated.

### **Immunohistochemical method**

Twist, e-cadherin and integrin  $\beta$ -1 antibodies were immunohistochemically stained by the Avidin-Biotin Complex (ABC) method. 4 micron thick sections were taken. After keeping the sections in an incubator at 58oC for 12 hours, they were deparaffinized for 30 minutes and then dehydrated by keeping them in 100% (absolute), 96%, 90% and 80% ethyl alcohol for fifteen minutes. Finally, it was washed in spring water for 1 minute and passed through distilled water. In order to reveal the antigenic structures masked in the tissue due to formalin fixation and paraffin blocking, the sections where all 4 antibodies will be applied were placed in 1X Tris Edta solution (0.01M sodium-citrate buffer, pH:8.00) for the first 5 minutes, medium for the second 5 minutes Microwave operation was performed on medium during the last 5 minutes and on high during the last 5 minutes. Sections were then kept at room temperature for 30 min and washed three times with distilled water followed by PBS.

### **RESULT**

In sections stained with Twist and snail antibody, red nuclear and cytoplasmic staining, and in sections stained with e-cadherin and integrin  $\beta$ -1, red membranous staining was considered positive. For Twist, snail, and e-cadherin antibodies, the percentage of stained cells was determined by calculating the ratio of stained cells to total cells in 4 high magnification fields. The percentage of stained cells was scored as 1(+) if it was less than 25%, 2 (+) if it was between 25-50%, and 3 (+) if it was more than 50% (12). Staining intensity was scored from 1 to 3 according to the degree of expression observed in the cells. Immunostaining was given as an immune score -H- score obtained by multiplying both scores together (13). Immunostaining intensity for integrin  $\beta$ -1 antibody was evaluated and calculation was performed. Staining intensity was evaluated using a scale similar to that used by Modolo et al. and Wahlgren et al. (14, 15). Positively emerging cases were also evaluated in terms of the criteria given below (Table 3.1).

Table 3.1. Evaluation criteria of positive cases

<b>The location of the cell</b>	<b>Epithelial basal layer</b>
	<b>Suprabasal layer</b>
	<b>Spinous layer</b>
	<b>Stellate reticulum</b>
<b>Keratin positivity</b>	
<b>Stromal cell positivity</b>	<b>Endothelium</b>
	<b>Fibroblast</b>
<b>Expression in epithelial buds</b>	
<b>Expression in mural areas</b>	

The obtained data were statistically evaluated using the IBM SPSS Statistics 23 package program. Descriptive statistics (mean  $\pm$  standard deviation) for numerical variables and frequency distribution for categorical variables were given while evaluating the data obtained on the work. The difference between two independent groups was analyzed by the Mann Whitney U test and the Kruskal Wallis test if there was a difference between more than two independent groups. Spearman's Rho correlation analysis was used to always analyze the relationship between two variables.

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**STATUS OF THE CONTAMINATION LEVEL OF GASTROINTESTINAL NEMATODE  
PARASITES IN SMALL RUMINANTS OBTAINED IN YAURI EMIRATE, KEBBI STATE,  
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**ABSTRACT**

Parasitism in small ruminants is a serious problem afflicting many farmers globally. Environmental characteristics such as favorable climatic and soil conditions considerably influence development of gastro-intestinal helminth on pastures and their capacity to inflict damage to livestock. Diminished nutritional status, compromised immunity and free grazing habits on pastures among the reared livestock increases the susceptibility of livestock to infective stages of gastrointestinal helminthes. The aim of this study was to determine the contamination level of gastrointestinal nematode parasites in goat and sheep in Yauri Emirate, Kebbi State, Nigeria. A total of 214 fecal samples from diagnosed animals were examined for the presence of eggs and oocysts of helminth parasites using quantitative and qualitative techniques. The overall occurrence of the parasites was 100%. The highest prevalence of the GIN parasitic infection (46.3%) was recorded for (*Ascaris spp.*), while the lowest prevalence infection (0.5%) was recorded for *Ostertagia spp.* In respect to sex, female had higher occurrence of contamination (56.54%) than the male (43.46%). There was no statistical association between the prevalence of infection and the sex of the animals. Furthermore, animals aged between 1-3 had the highest prevalence of infection (49.1%), at the same time as those aged >3 recorded the least incidence (24.3%). However, there was no statistical association between the prevalence of the parasites infection and the age of the animals. This study conclusively revealed that there was high prevalence of gastrointestinal helminth parasites in Yauri Emirate. Therefore, there is an urgent need for proper grazing management and routine prophylactic treatment of livestock.

**Key Words:** Status, Nematodes, Parasites, Goat, Sheep, Yauri.

**INTRODUCTION**

Infection of ruminants with Gastrointestinal Parasites is widely reported from all corners of the world and shown to be influenced by the type of cattle management practiced (Raza *et al.*, 2010). The most important predisposing factors for parasitic infections are grazing habits, climate, nutritional deficiency, pasture management, poor immunological status, presence of vector and intermediate host, and the number of infective larvae and eggs in the environment (Edosomwan *et al.*, 2012). The effect of parasitic infections is determined by a combination of factors, of which the varying susceptibility of the host species, the pathogenicity of the parasite species, the host/parasite interaction, and the infective dose are the most important (FAO, 2000). According to Singh *et al.* (2014), the effect of infection by gastrointestinal parasites varies according to the parasite concerned, the degree of infection and other risk factors such as species, age, season and intensity of worm burden.

Nematodes (round worms) are free-living unsegmented worms, which have cylindrical form, tapering

at either ends. Their body is covered with a colorless, somewhat translucent layer called the cuticle, are elongated in shape and an alimentary canal is present (Urquhart, *et al.*, 1997). They have separate sexes and exhibit both direct and indirect life cycle, are found in fresh water, the sea and the soil and are among the most successful parasites of plants and animals (Soulsby, 1982).

They therefore, make up a large assemblage of relatively simple structure with a wide spread distribution and their cylindrical non segmented bodies easily distinguishes them from other helminthes. They occur in fresh water, in the sea and in soil and are among the most successful parasites of plants and animals. Most of the free- living nematodes are microscopic, as are many of the parasitic species invading the body fluids such as the blood or lymph channels of their hosts. These species which live in the intestine are generally larger, while some in tissue habitats (e.g. the kidney) grow to relatively enormous lengths (Smyth, 1994).

According to Troncy, (1989).gastrointestinal nematodes are numerous parasites which develop within the digestive tract (abomasum, intestines) of domestic ruminants. They include a range of nematode species, which belong to the order Strongylida and their parasitic infection is one of the major global health problems. (Gillian, *et al.*, 2004; Hale, 2006 and Fikru *et al.*, 2006).

Gastrointestinal nematodes of greatest importance in ruminants are *Haemonchus*, *Osophagostomum*, *Chabertia*, *Bunostomum*, *Ostertagia*, *Trichostrongylus*, *Gaigeria* which lays eggs of similar feature like strongyle and identified by fecal culture at larval level. Whereas *Trichuris*, *Nematodirus* and *Strongyloides* produce distinct eggs (Hassan *et al.*, 2013). The major weapons used to fight the problem of gastrointestinal parasitism are “Anthelmintic” but however, the frequent use of these drugs over many years by farmers has led to the unavoidable development of drug resistance by these parasitic nematodes (Singh, *et al.*, 2002)

Adult female nematodes produce eggs that are deposited out via the host’s feces. Under ideal external environment conditions, the first- stage larvae ( $L_1$ ) develops and eggs are hatched within 24 hours.  $L_1$  grow and develop to second-stage larvae ( $L_2$ ), which then grow and develop into third -stage larvae ( $L_3$ ). Generally, the third stage larvae are the infective. After ingestion, the  $L_3$  larvae develop into fourth-stage larvae ( $L_4$ ), which then develop into juvenile adults. Sexually mature adult nematodes develop within 2 to 4 weeks after ingestion of the  $L_3$  except arrested larvae development occur (Zelalem, and Fletcher, 1991)

The egg and larvae of nematodes are most often diagnosed fecal floatation and fecal culture (Hendrix, 1998). Flotation technique using floatation fluid in which the specific gravity is higher than that of the eggs is normally applied to detect the presence of nematode eggs and larvae in a fecal sample. The egg in the flotation fluid will float up to the surface since nematode and cestode eggs float in a liquid with specific gravity of between 1.10 and 1.20; trematode eggs which are much heavier, require a specific gravity of 1.30-1.35.The floatation solution used for nematode and cestode eggs in this experiment was Sodium chloride (Taylor, *et al.*, 2007).

Gillian, *et al.*, (2004) reported that nematode infections affect the health of millions of people and animals, causing huge economic loss in livestock farming. Infections by gastrointestinal nematodes are a global problem for both small and large scale farmers since they create a serious health hazard and reduces the productivity of livestock due to the associated morbidity and mortality. Moreover, due to the availability of a wide range of agro-ecological factors suitable for diversified hosts and parasite species, their impact is greater in sub-Saharan Africa in general. Gastrointestinal parasites causes economic losses in a variety of ways such as lowered fertility, reduced work capacity, involuntary culling, a reduction in food intake and lower weight gains, reducing milk production, treatment costs, and death in heavily parasitized animals (Lebbie *et al.*, (1994).

In addition, the diverse agro-climatic conditions, animal husbandry practice and pasture management largely determine the incidence and severity of various parasitic diseases in certain area. Additionally, the prevalence of gastrointestinal parasites, the genera of helminth parasites involved, species and the severity of infection also vary considerably depending on local environmental conditions such as humidity, temperature, rainfall, vegetation and management practices (Barger, 1999 and Kassai, 1999). Therefore, excess of parasitic diseases plays a damaging role in hindering small and large ruminant

production leading to serious economic loss (Nwosu *et al.*, 2007).

The significant losses caused by gastrointestinal parasitism, are some problems that are often neglected and overlooked as majority of the infected animals show a number of little obvious clinical signs during their productive life and their effects are gradual and chronic (Raza *et al.*, 2010). Indirect losses associated with parasitic infections include the reduction in productive potential such as decreased growth rate, weight loss, diarrhoea, anorexia, and sometimes anaemia (Swai *et al.*, 2006).

Depending on the local climatic condition, like humidity, temperature, rainfall, vegetation and management practices, the epidemiological studies of gastrointestinal (GIT) nematodes in livestock varies. These factors largely determine the occurrence and severity of numerous parasitic diseases in an area (Takelye, B 1991). Clinical diagnosis of GI nematodes is difficult, since the signs and symptoms of the diseases they cause are not singly diagnosed. However, diagnosis of gastrointestinal nematode infections plays an important role in exploring parasite epidemiology. The ante mortem diagnosis of nematode infections in livestock has been based on the detection of nematode eggs or larvae in the feces by microscopic examination using the methods of flotation and/or larval culture (Takelye, 1991).

Therefore, considering the significance of the parasite as one of the most important causes of economic losses and the scarcity of information in the area, the present study was designed to determine the prevalence of gastrointestinal nematodes (GIT) in Yauri Emirate, Kebbi State, Nigeria

## **MATERIAL AND METHODS**

### **Study Area**

The study was conducted on goats and sheep from the three Local Government Areas in Yauri Emirate that were slaughtered at different abattoirs. The Emirate, is located in Kebbi State. It is located in Northern Nigeria and in the South eastern part of Kebbi state at latitudes 11° 15'-12° 30' N and longitudes 5° 18'- 11° 20' E. Yauri is the headquarters of the Emirate and Yauri Local Government Area as well. The emirate has three Local Government Areas comprising of Ngaski (with headquarters at Warra), Shanga (with headquarters at Shanga) and Yauri. (With headquarters at Yauri). It is in the Kebbi South Senatorial districts, comprising of Danko/Wasagu, Fakai, Ngaski, Shanga, Yauri and Zuru Local Government Areas.

### **Study Design**

A cross-sectional examination was performed to determine the prevalence of gastrointestinal helminth parasites in Yauri Emirate, from October, 2019 to April, 2020. An introductory assessment was carried out prior to the sample collection to brief the personnel in charge of the abattoirs or slaughter points and butchers on the goals of the study. Furthermore, convenience sampling technique was adopted in selecting the abattoirs and sample collection centers for financial convenience, accessibility and easy reach. The study animals were randomly selected for fecal samples, irrespective of their sex and age, (James, 2014). A systematic random sampling procedure was applied to select the animals for fecal collection in each of the locations in the Local Government Areas (Yauri: Yauri, Rukubalo and Tondi; Shanga: Shanga, Saminaka and Tungar Giwa; and Ngaski: Ngaski, Warra and Makirin) as adopted by Attah and Galamaji (2019).

### **Sample Size Estimation**

The study was conducted from October, 2019 to April, 2020, at different abattoirs in the three (3) Local Government Areas. The sample size for the study was calculated according to the formula given by Thrusfield (2005)

The formula is given as:

$$n = \frac{1.96^2 P_{exp}(1 - P_{exp})}{d^2}$$

Where n = required sample size

P<sub>exp</sub> = minimum expected prevalence



d = Expected absolute precisions 5% (0.05) and confidence level 95%

### Sample collection

Visits were done to the abattoirs weekly for the sample collection during the period of study (October 2019 – April, 2020) as early as 7:30am when the animals are usually taken to the abattoir for slaughter. The animals were identified and labelled as male or female. A total of 350 fresh fecal samples of 136 cattle, 101 goats, and 113 sheep were collected directly from the rectum of the slaughtered animals using a pair of hand gloves and placed into clean labelled polythene bags. The samples were transported to Zoology laboratory of the Kebbi State University of Science and Technology, Aliero, Nigeria for microscopic examination as adopted by Ogudo et al. (2015) and Olurumfemi et al. (2015)

### Laboratory Evaluation of Fecal Samples

Simple Sedimentation procedure was used to examine the fecal samples to identify the eggs and cysts of the parasites as adopted by Yassir et al. (2017). Conversely, parasites that cannot be recognized at egg level were subjected to simple test tube flotation method, cultured and harvested via Baermann techniques for the sexistence of parasite larvae. Eggs or oocysts had been identified using the light microscope at x100 objective, and classified as described by Urquhart, et al. (1987)

### Larval Cultures and Identification

Helminth eggs of the strongylid type cannot be identified to species level. In order to differentiate between these helminths, it is imperative to make fecal cultures wherein the eggs will hatch and the larvae develop to the infective level (L<sub>3</sub>). These L<sub>3</sub> larvae might then be identified to genus level microscopically. It is important that the fecal samples are collected rectally, as feces picked up from the ground is usually infected with free-living nematodes. The latter will multiply unusually at a rapid rate in the cultures and absolutely outnumber the parasite larvae, which may then be hard to locate. Parasites have been identified the using charts and keys described by using Soulsby, E (1982) and Lynne et al. (2018).

### Statistical Analysis

The data collected were analyzed using SPSS model 20.0. Descriptive statistics was used to compute the prevalence of every parasite type. Pearson's Chi-rectangular (X<sup>2</sup>) was used to determine the presence of association between occurrence of parasite in terms of the species, age and sex of animals as described by Shimelis et al. (2011). Confidence level was held at 95% and P< 0.05 stage of significance.

## RESULTS

The prevalence of Nematodes in relation to the types of ruminants in the study area was indicated in Table 1. The highest prevalence (43.7%) was recorded for *Ascaris spp.* While the least prevalence (0.1%) was recorded for *Ostertagia spp.* However, there was no statistical association between the prevalence of nematodes and the study animals (P>0.05).

Table 1 Prevalence of Nematodes in Relation to the Types of Ruminants in Yauri Emirate, Kebbi State, Nigeria

	Parasites	Goat n=101	Sheep n=113	Total n=214	
	Nematodes	No.Inf. (%)	No.Inf.(%)	No.Inf. (%)	X <sup>2</sup>

1	<i>Ascaris spp</i>	54 (53.5%)	45 (39.8%)	99(41.3%)	<b>13.16</b>
2	<i>Bunostomum spp</i>	10 (9.9%)	10 (8.8%)	20(9.3%)	
3	<i>Cooperia spp</i>	9 (8.9%)	12 (10.6%)	21(9.8%)	
4	<i>H. contortus</i>	11 (10.9%)	7 (6.2%)	18(8.4%)	
5	<i>Ostertagia spp</i>	0 (0.0%)	1 (0.9%)	01(0.5%)	
6	<i>S. papillosus</i>	9 (8.9%)	1 (0.9%)	10(4.7%)	
7	<i>T. columbriformis</i>	2 (1.9%)	4 (3.5%)	06(2.8%)	
8	<i>Trichuris trichiura</i>	10 (9.9%)	11 (9.7%)	21(9.8%)	
	<b>TOTAL</b>	<b>105 (30.0%)</b>	<b>91 (26.0%)</b>	<b>196 (100%)</b>	

**P-value=14.07**

**Table 2:** Prevalence of Nematode Parasites in Sheep and Goat by Age in the Study Area.

<b>RUMINANT</b>									
S/No	Age	Sheep	% INF.	Goat	%INF.	Total Inf.	% INF.	X <sup>2</sup>	P-Value
1	<1	17	15.0%	10	9.9%	27	16.6%	3.6	5.99
2	1 to 3	83	73.5%	71	70.3%	154	72.0%		
3	>3	13	11.5%	20	19.8%	33	15.4%		
	<b>TOTAL/%</b>	<b>113</b>	<b>100%</b>	<b>101</b>	<b>100%</b>	<b>214</b>	<b>100%</b>		

**Table 3:** Prevalence of Nematode Parasites in Sheep and Goat by Sex in the Study Area.

RUMINANTS									
S/No	Sex	Sheep	%INF	Goat	%INF	Total Inf.	%INF	X <sup>2</sup>	P-Value
1	Female	59	52.2%	62	61.4%	121	56.5%	2.66	3.84
2	Male	54	47.8%	39	38.6%	93	43.5%		
	<b>TOTAL</b>	113	100%	101	100%	214	100%		

## DISCUSSION

The prevalence of Nematodes in relation to the ruminant species in the study area shows that the highest prevalence (46.3%) was recorded in *Ascaris spp.* while the lowest (0.5%) was recorded for *Ostertagia spp.* This result disagrees with that of Olorunfemi *et al.* (2015), whose results indicated *T. columbriformis* recording higher prevalence and the least prevalence was in *H. contortus*. However, Abdulaziz and Aburhaman recorded a higher contamination of nematode parasites in *Strongyloide papillosis* (33.33%) and the least (10.68%) was in *Fasciola hepatica* which is different from the result of this study.

The current study revealed an overall prevalence of 100%, gastrointestinal nematode infection of ruminants. This result is almost similar to reports in Elisa, *et al.*, (2022) who obtained 88.2% overall prevalence of nematodes contamination in sheep from Cordoba, Columbia and that of Ameen, *et al.*, (2015) who recorded 80.7% nematode prevalence in cattle, in Ogbomoso, Oyo State, Nigeria. In addition, the overall prevalence of nematode parasites in this study is nearly similar with that of Ruhullaha *et al.*, (2021) who observed (89.2%) in sheep and (94.0%) respectively. This result is higher than that of Adedipe, *et al.*, (2014) who observed 41.6% overall prevalence of gastrointestinal helminth contamination in cattle slaughtered in Ibadan, South-Western Nigeria, as well as the result of Abdulaziz and Abdurrahman, (2022) who recorded 52.34% contamination prevalence of gastrointestinal nematodes in small ruminants in Adami Tulu Jiddo Kombolcha District, East Shoa, Oromia, Ethiopia.

In this study, higher prevalence was recorded in goat (30.0%) followed by sheep (26.0%) which is similar with the result of Yobsan, *et al.*, (2018) having 36.7% overall prevalence in sheep and the least (28.9%) was recorded in goat, which is also similar with the result provided by Elshahawy *et al.*, (2014) who obtained (24.44%) overall prevalence of GIH of slaughtered goats in Upper Egypt, Egypt, but lower than that of Yimer *et al.*, (2018) having 41.2% prevalence in Bovine in Kombolcha and Resre Town, Ethiopia..

The present result could be attributed to differences in management system, topography, de-worming practices, and climatic condition that favor the survival of infective stage of the parasite. Statistical analysis has revealed that; there is no Significant relation ( $P > 0.05$ ) between the examined animals and occurrence of GIT nematodes.

Age-wise prevalence showed that animals aged 1 to 3 recorded higher (72.0%) parasite contamination compared to those aged <1 and >3 with 16.6% and 15.4% respectively. Furthermore, no significant association was observed between the nematode contamination level and the animals examined. This result is almost similar with that of Abulaziz and Abdurhaman, (2022) who reported a higher prevalence of the nematode parasites in young animals (32.8% and 26.0%) in sheep and goat and least contamination level in adults (28.1% and 17.7%) in sheep and goat respectively.

With respect to sex of the animals, this study observed that females harbor more nematode parasites (56.5%) than the males recording less (43.5%) percentage contamination of the gastrointestinal nematodes. There is no statistical association between the prevalence of the parasites and the sex of the animals diagnosed. This study is similar with that of

## **Conclusion and Recommendations**

Gastrointestinal nematode parasites are the major animal health constraints in livestock production constituting a major loss to the economy. Therefore, this finding observed that helminth parasites are much prevalent in the study area. It is therefore suggested that proper screening and monitoring of ruminant animals with regular and strategic deworming programs be carried out and further studies should be conducted to determine the seasonal prevalence of GIT parasites of cattle, goat and sheep in the study area. However, farmers should be educated on the importance of the parasitic diseases, its economic losses and the correct ways to improve animal husbandry system need to be applied.

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**YAŞLILARDA KARIN BOŞLUĞU, AKUT APANDISIT VE AKUT TAŞ KOLESİSİTİT  
HASTALIKLARININ CERRAHI TEDAVİ YÖNTEMLERİ**

**METHODS OF SURGICAL TREATMENT OF DISEASES OF THE ABDOMINAL CAVITY,  
ACUTE APPENDICITIS AND ACUTE STONE CHOLECYSTITIS IN ELDERLY PEOPLE**

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## **ÖZET**

Akut karın terimi, nedeni bilinmeyen akut şiddətli və ya akut təkrarlayan karın ağrısı anlamına gəlir. Akut karın acil tanı və sıklıqla ameliyat gərəktirir. Akut karın aşağıdakılardan kaynaklanabilir. Akut kolesistit, akut pankreatit, akut apandisit, bağırsaq tıkanıklığı, akut peritonit, mide və duodenal ülserlərin perforasyonları, bağırsaq divertikülitlərinin perforasyonları, safra kesesi duvarının perforasyonu vb. anlamına gəlir. Akut karının başlıca klinik səbəbləri şunlardır: Şiddətli, ani və ya sürəkli lokal və ya yayılan karın ağrısı, peritoneal simptomlar, barsaq peristaltizmi, kan dövşəm bozuklukları, şok, dışkılama hərəkətində əksiklik, genel durum bozukluğu.

**Anahtar Kelimələr:** Karın xəstəlikləri, Akut apandisit, Akut taşli kolesistit

## **ABSTRACT**

The term acute abdomen refers to acute severe or acute recurrent abdominal pain of unknown cause. Acute abdomen requires immediate diagnosis and often surgery. Acute abdomen can be caused by: Acute cholecystitis, acute pancreatitis, acute appendicitis, intestinal obstruction, acute peritonitis, perforations of stomach and duodenal ulcers, perforations of intestinal diverticulitis, perforation of the gallbladder wall, etc. It means. The main clinical causes of acute abdomen are: Severe, sudden or persistent local or radiating abdominal pain, peritoneal symptoms, intestinal peristalsis, blood circulation disorders, shock, defecation deficiency, general condition disorder.

**Keywords:** Abdominal diseases, Acute appendicitis, Acute stone cholecystitis

Akut karın terimi, nedeni bilinmeyen akut şiddətli və ya akut təkrarlayan karın ağrısı anlamına gəlir. Akut karın acil tanı və sıklıqla ameliyat gərəktirir. Akut karın aşağıdakılardan kaynaklanabilir. Akut kolesistit, akut pankreatit, akut apandisit, bağırsaq tıkanıklığı, akut peritonit, mide və duodenal ülserlərin perforasyonları, bağırsaq divertikülitlərinin perforasyonları, safra kesesi duvarının perforasyonu vb. anlamına gəlir. Akut karının başlıca klinik səbəbləri şunlardır: Şiddətli, ani və ya sürəkli lokal və ya yayılan karın ağrısı, peritoneal simptomlar, barsaq peristaltizmi, kan dövşəm bozuklukları, şok, dışkılama hərəkətində əksiklik, genel durum bozukluğu. 3 çeşit ağrı vardır.( Thomas JN, Gordon AH.,2004),

**Nöbet benzeri iç organ ağrıları** - donuk, derin, yaygın, genelliklə nöbet benzeri, hasta tam yerini söyleyemez. Visseral ağrılar, içi boş bir organın gerilmesi, kas kəsilmələri, bağırsağın ağırlı hiperperistaltizmi və ya organ kapsülünün ani gerilmesi sırasında ortaya çıkar, örneğin ureteral spazmlar, safra kesesi spazmları, karaciğer kapsülü spazmları vb. Ani şiddətli ağrı, bir boşluğun delinməsinin və ya

abdominal aort anevrizmasının bir işareti olabilir.( Farahnak M, Talaei-Khoei M, Gorouhi F, Jalali A, Gorouhi F.,2007),

**Kronik somatik ağrı** - keskinleşir, yanar, hasta yerini tam olarak söyleyebilir. Enflamasyon, vücudun yaralanması veya embolisi sonucu oluşur ve periton, mezenter, mezokolon, peritoneark bölgesinden kaynaklanır.( Bennett J, Boddy A, Rhodes M.,2007),

**Kas savunması**- lokal olarak başlayıp tüm mideye yayılabilir. Ateş ve enflamatuvar göstergelerde artış ile peritonizm gözlenirse, bu akut karına peritonitin eşlik ettiğini gösterir.

Ağrı, hastalar üzerinde ciddi fiziksel ve psikolojik etkisi olan en yaygın semptomlardan biridir. Ağrının tıbbi geliştiren etkenlerden biri olduğu söylenebilir. Tıbbın ilk başarısı ağrı kesicidir.( Farahnak M, Talaei-Khoei M, Gorouhi F, Jalali A, Gorouhi F.,2007),

Abdominal ağrı sendromu yani karın ağrısı, klinik pratikte karın boşluğunda yer alan organların çoğu hastalığı ile ilişkilendirilmektedir. Karın ağrısı çeşitli sebeplerden kaynaklanabilir. Buradaki asıl amaç ağrıyı ayırt etmektir yani bu rahatsızlık sıradan bir köpüklenmeden kaynaklanabilir veya ciddi bir patolojik sürecin belirtisi olabilir.Genellikle birkaç saniye ile 2-3 dakika arasında süren ağrı bir ağrı değildir. endişe nedeni.

**Karın ağrısı esas olarak visseral ve somatiktir:**

**Visseral ağrı**, içi boş organların duvarlarında bulunan sinir uçlarının tahrişinden kaynaklanır. Bunlar o organın spazmindan veya genişlemesinden kaynaklanabilir. Bu ağrıların şiddeti ve dağılımı farklıdır.

**Somatik ağrı**, omurilikten gelen peritonu innerve eden sinir uçlarının tahriş olması sonucu oluşur. Visseral ağrıların aksine, somatik ağrı sabittir, lokalizedir, peritonun ön duvarındaki kas gerginliğinin eşlik ettiği, doğası gereği kesicidir, hareket ve nefes alma sırasında artar, bu nedenle hastalar zorlanır.( Bennett J, Boddy A, Rhodes M.,2007),

**Bunlar karın ağrısına neden olan ana hastalık grupları ve patolojik durumlardır.**Karın boşluğu,mide ve duodenum,karaciğer ve safra yolları,pankreas,bağırsaklar,dalak,gıda toksikoenfeksiyonu,iltihabı ve zararları organlarının fonksiyonel veya organik hastalıklarıdır. periton, böbrek ve idrar Sindirim sistemi hastalıkları, karın boşluğunda lokal arteriyel kan dolaşımı, bazı sinir sistemi hastalıkları, hiperlipoproteinemi, diyabet, tirotoksikoz vb. Bu tür hastalıklarda akut karın ağrısı nadiren görülür.( Qarayev Q.Ş. Əliyev Ş.X., Əliyev Y.Q. Həsənov M.J.,2008),

**Akut apandisit:** Karnın sağ tarafında ağrı akut apandisit düşündürülebilir. Akut apandisit, apendiksin akut inflamatuvar bir hastalığıdır ve en yaygın cerrahi acil durumdur. Hastalık her yaş grubunda görülebilmekle birlikte en sık 10-30 yaş grubunda görülmektedir. Akut apandisit ilerleyici bir hastalıktır ve yüzey-mukozal enflamatuvar süreç gelişerek yıkıcı formlara ve komplikasyonlara yol açar. Akut apandisit için standart tedavi açık veya laparoskopik apendektomidir. Akut apandisit en yaygın cerrahi acil durumdur. Akut apandisit toplumun yaklaşık %2-7'sinde bulunur.Akut apandisit etiyojisi tam olarak bilinmemekle birlikte sfinkter benzeri çıkıntının tıkanmasına bağlı olarak bulunur (vakaların %60'ında neden olduğu düşünülmektedir). Fibröz doku, lenfoid hiperplazi, dışkı taşları ve hatta parazitler çıkıntıda tıkanıklığa neden olabilir. Dışkı taşları hastaların yaklaşık %10'unda bulunur. Birincil bağırsak enfeksiyonları ve venöz tromboz da akut apandisite neden olabilir.( Qarayev Q.Ş. Əliyev Ş.X., Əliyev Y.Q. Həsənov M.J.,2008)

Apendiks boşluğundaki tıkanıklık, akut apandisit ana nedenidir. Fekalit (katı bir dışkı kütleli), normal dışkı veya lenfoid hiperplazi, tıkanıklığın ana nedenleridir. Fekalit tek başına vakaların %40'ında basit apandisite, %65'inde perforasyonun olmadığı gangrenöz apandisite ve vakaların %90'ında perfore apandisite neden olur. Bazı hastalık fenomenlerinde nöroimmün bir etiyojiji işaret eden bilimsel kanıtlar vardır, ancak bu hala araştırılmaktadır.( Ашрафов P. A.,2002),Akut apandisit, cerrahi müdahale gerektiren ve son derece tehlikeli bir hastalık olan apandisit iltihabıdır.Ağrı aniden midede veya göbek çevresinde belirir, ardından tüm karını kaplayabilir ve birkaç saat sonra da hissedilebilir. belli bir yerde, genellikle sağ kalça bölgesinde Lokalizasyon Ateş, bulantı ve kusma görülebilir Apandisit sırasında ağrı karın sağ üst yarısında lokalizedir İltihaplı apandisit çekumun arkasında yer alıyorsa ağrı belin alt kısmına veya tüm karın bölgesine yayılabilir İltihaplı apandisit pelvise yerleştirildiğinde, bölgedeki sağ kalça deliği ağrılarına komşu organların iltihaplanma belirtileri eşlik



eder - sistit, sağ taraflı adneksit.( Zudema GD.,2006),

Yaşlı insanlarda, yukarıda belirtilen semptomlar zayıf bir şekilde not edilir, çünkü vücudun tepkisi yaşa bağlı olarak daha düşüktür. Küçük çocuklarda akut apandisit belirtilerinin özellikleri şunlardır: huzursuzdurlar, yemek yemeyi reddederler, şiddetli ağrı sırasında çığlık atarlar, ağız kuruluğu oluşur, vücut ısısı 38-39 ° C'ye yükselir.Genellikle hayati belirtilerde önemli bir değişiklik olmaz. Taşikardi ve ağız kokusu da mevcut olabilir. Klasik belirti sağ alt karın hassasiyetidir (McBurney belirtisi) ve eğer apendiks anterior ise lokalize bir Shetkin-Blumberg belirtisidir. Sol alt kısmı sıktıktan sonra sağ alt kısımda ağrı olabilir (Rovsing belirtisi).( Мишнев О.Д., Щеголев А.И.,2001),Hamstring gerginliği veya sıkı sağ uyluğun iç rotasyonu (obturator işareti) nedeniyle ağrı, hasta sol tarafa yattığında başlar ve yavaş yavaş sağa doğru hareket eder.( Tzovaras G, Liakou P, Baloyiannis I, Spyridakis M, Mantzos F.,2007),Bağırsak sesleri özellikle sağ taraf ile sol taraf karşılaştırıldığında azalabilir.Kurulucan benzeri çıkıntı atipik bir pozisyonda ise klasik karın semptomları olmayabilir.Perforasyonlu hastalar geldiğinde akut hastadırlar ve gergin, genişlemiş karın, genel koruyucu fiksasyon ve bağırsak seslerinin olmaması Solucan benzeri çıkıntının perforasyonu yağda kalan dik bir apse ile sonuçlandığı için ele gelen bir kitle hissedilebilir.( Мишнев О.Д., Щеголев А.И.,2001),

Akut apandisit, ilerleyici enflamatuar-yıkıcı bir hastalık olarak kabul edilir. Hastalık genellikle mukoza zarında meydana gelen inflamatuvar bir süreçle başlar. İnflamasyonun gelişmesi sonucu orifiste irin birikir, çıkıntının duvarındaki kanlanma bozulur ve 24-48 saat içinde duvarda nekroz ve perforasyon meydana gelir. Perforasyon apse, peritonit, piyofilit gibi tehlikeli komplikasyonlara yol açabilir.( Zudema GD.,2006),

Apendiks BT, akut apandisit için ilk tanı testi olarak giderek daha fazla kullanılmaktadır ve Amerika Birleşik Devletleri'nde BT, akut apandisit semptomlarıyla acil servise başvuran hastalar için rutin olarak önerilmektedir. Ameliyatta gecikme apendiküler perforasyon olasılığını artırdığından, BT taramasının atipik belirtileri olan hastalarda seçici olarak kullanılması gerektiği varsayılmaktadır. Tarama protokolleri bölgelere göre değişebilir ve hastalar yerel hastane kılavuzlarını kullanmalıdır. Oral kontrastlı veya kontrastsız intravenöz kontrastlı BT'nin duyarlılığı %100'dür ve intravenöz olmayan kontrastlı BT'nin duyarlılığı %92'dir.Akut apandisit durumunda acil tıbbi yardım aranmalıdır.Yiyecek ve sıvı alımı,ağrı kesici kullanımı yasaktır.Karına buz tatbik edilmelidir.( Ашрафов Р. А.,2002),

Akut apandisit tanısı konulduktan sonra hastaların ağızdan gıda alması engellenmeli, Ringer laktat solüsyonu dahil intravenöz sıvılar verilmelidir. Ameliyattan sonra profilaktik intravenöz antibiyotik kullanımı kontrendikedir. Akut apandisit komplikasyonları, hastaların %4-6'sında görülür ve kangren ve müteakip perforasyon veya karın içi apsesi içerir. İlk tedavi, hastanın oral alımını kesmeyi ve intravenöz sıvıları başlatmayı içerir. Şoktaki hastalarda nabızı ve kan basıncını stabilize etmek için intravenöz antibiyotiklere hemen başlanmalı ve hastanın ateşi düşene ve lökositozu düzeline kadar devam edilmelidir. Akut peritonitli hastalarda vakit kaybetmeden apendektomi yapılmalıdır.( Tzovaras G, Liakou P, Baloyiannis I, Spyridakis M, Mantzos F.,2007),

**Cerrahi seçenekler:** Apendektomi için 2 cerrahi seçenek vardır: açık ve laparoskopik.

Yetişkinlerde apendektomi seçimi genellikle cerrahın deneyimine bağlıdır. Çalışmalar, açık apendektomi ile karşılaştırıldığında, laparoskopik apendektominin daha iyi kozmetik sonuçlar, daha az hastanede kalma süresi ve daha az postoperatif ağrı ve yara enfeksiyonu riski sağladığını göstermiştir. Laparoskopik apendektomi, komplike apandisit ve ayrıca komplike ve perforan apandisit için önerilir. Fazla kilolu hastalarda da en güvenli yaklaşım olarak kabul edilir.( Mui LM, Ng CS, Wong SK, Lam YH, Fung TM, Fok KL.,2005),

**AKUT TAŞLI KOLESİSTİT-** sağ kotal bölgede ağrıya neden olabilir. Bu hastalıkların şiddetlenmesi safra kesesi boynundaki taşların, safra yollarının tıkanması, safra kesesinde enfeksiyon ve iltihaplanma ile ilişkilidir. Çoğu durumda, yanlış beslenme, aşırı fiziksel efor, stres vb. Akut taşlı kolesistit çoğu vakada (%90) safra kesesinin safra taşı ile tıkanması sonucu, nadir vakalarda ise taş dışı sebeplerle (sepsis, ağır travma, tromboz, yanıklar, pankreatit, büyük ameliyatlar sonrası, kemoterapi vb.) ortaya çıkar. ). Akut kolesistit acil cerrahi bir hastalıktır, muayene ve tedavisi geciktirilmeden yapılmalıdır.( Feldman M, Friedman LS, Sleisenger MH.,2002), Akut taşlı kolesistitin radikal tedavisi erken laparoskopik kolesistektomidir, muayene ve tedavi koledoks değerlendirmesi ile paralel yapılmalıdır.

Akut taşlı kolesistit en yaygın acil cerrahi hastalıktır ve popülasyonun %2-3'ünde ve safra taşı olan kişilerin %10-15'inde görülür. Yaş arttıkça akut kolesistit görülme sıklığı kadar safra taşı görülme sıklığı da artmaktadır. Taşlı kolesistitte taşın mesane çıkışını tıkaması sonucu intralüminal hipertansiyon, duvar iskemisi ve son olarak aseptik inflamasyon gelişir. Taşsız kolesistitte kist duvarındaki primer iskemi ve nekroz inflamasyonun başlamasına neden olur. Birincil aseptik inflamasyon, mukoza zarından başlar ve 24 saate kadar sürer. Bu aşamada tıkanıklık giderilirse dekompresyon oluşur ve 7-10 gün içinde iltihaplanma süreci kendiliğinden geriler. Tıkanıklık devam ederse ancak enfeksiyon oluşmazsa, kistteki safra pigmentleri emilir - hidropor adı verilen safra içeren beyaz bir kist oluşur. (Гараев Г.Ш., Мирзабекова Ф.И., 1990),

Tıkanıklık giderilmezse ve enfeksiyon sürece katılırsa, tüm duvarları kaplayan bulaşıcı iltihap - balgamlı kolesistit ve kangren başlar. Bu aşamada tıkanıklık devam ederse ampiyem - kapalı cerahatli safra mesanede toplanır. Bazı durumlarda, klostridial enfeksiyon amfimatöz kolesistite yol açar. Akut taşlı kolesistitte enfeksiyon kaynağı bağırsaklardır, çoğu durumda E.coli, Klebsiella, Enterococci, Bacteroidetes nadiren bulunur. Genel olarak akut taş kolesistit hastaların yaklaşık yarısında 7-10 gün içinde kendiliğinden düzelir, vakaların %30-40'unda yıkıcı inflamasyona neden olur, Vakaların %10-15'inde olur, hastaların yaklaşık %30'unda bir ay içinde tekrarlayabilir, vakaların %10-15'inde koledoks patolojisi eşlik eder veya şiddetlenir. (Feldman M, Friedman LS, Sleisenger MH., 2002),

**Semptomlar:** Sağ kosta bölgesinde ani başlayan ve devam eden akut nöbet benzeri ağrı, sırtın sağ kısmına yayılan, karın boyunca, mide bulantısı, geçmeyen safra ile kusma, ateş, nötrofilik lökositoz, deride sarılık ve görünür mukoza zarları, hastalar çok endişeli, Sürekli vücut için rahat bir pozisyon arıyor Böyle bir durumda tam bir sakinlik ve uyku modu oluşturmak, ambulans çağırmak, doktordan önce sıvı, yiyecek ve ilaç almak kesinlikle yasaktır. geldiğinde. (Mui LM, Ng CS, Wong SK, Lam YH, Fung TM, Fok KL., 2005),

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**ÇEVRENİN, ZARARLI MADDELERİN İNSAN FİZYOLOJİSİ ÜZERİNDEKİ ETKİSİ VE  
ENDOKRİN SİSTEM ÜZERİNDE YARATAN PATOLOJİLER**

**THE IMPACT OF THE ENVIRONMENT, HARMFUL SUBSTANCES ON HUMAN  
PHYSIOLOGY AND PATHOLOGIES CAUSED ON THE ENDOCRINE SYSTEM**

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**ÖZET**

Çevre kirliliği - normların üzerinde üretim yan ürünleri ile dış ortamdaki değişikliklerin bir sonucu olarak ortaya çıkar. Kirletici unsurlar arasında katı, sıvı ve gaz halindeki maddeler, zararlı radyasyon bulunur. Ağır metaller (cıva, kurşun, kadmiyum), fosfatlar, nitratlar, kükürt oksitler, tarımsal zararlı ve hastalıklarla mücadelede kullanılan zehirli kimyasallar, iyonlaştırıcı radyasyon, radyoizotoplar, endüstriyel ve trafik gürültüsü daha zararlı kabul edilmektedir. Yukarıda belirtilen maddelerden bazıları mutajenik etki göstererek kansere neden olabilir. Şu anda, kirliliğin sıkı kontrolünün önemi insanlığın önünde ortaya çıkmıştır. Dış dolgularının içerdiği ağır metaller (gümüş, cıva, amalgam, nikel vb.) beyin ve sinir sistemi için (nöromusküler hastalıklar, otizm, dikkat eksikliği sendromu, depresyon vb.) endokrin sistem üzerinde patojenik bir etki. Şu anda, bazı ülkelerde amalgam kullanımı tamamen yasaklanmıştır, bazı ülkelerde sadece hamile kadınlar için yasaklanmıştır.

**Anahtar Kelimeler:** Çevre, Zararlı maddeler, Endokrin sistem

**ABSTRACT**

Environmental pollution - occurs as a result of changes in the external environment with by-products of production above the norm. Polluting elements include solid, liquid and gaseous substances, harmful radiation. Heavy metals (mercury, lead, cadmium), phosphates, nitrates, sulfur oxides, toxic chemicals used in the fight against agricultural pests and diseases, ionizing radiation, radioisotopes, industrial and traffic noise are considered more harmful. Some of the above-mentioned substances can cause cancer by having a mutagenic effect. At present, the importance of strict control of pollution has emerged in front of humanity. Heavy metals included in dental fillings (silver, mercury, amalgam, nickel, etc.) are highly toxic to the brain and nervous system (neuromuscular diseases, autism, attention deficit syndrome, depression, etc.), they also affect the immune and has a pathogenic effect on the endocrine system. At present, the use of amalgam is completely prohibited in a number of countries, while in some countries it is prohibited only for pregnant women.

**Keywords:** Environment, Harmful substances, Endocrine system

Çevre kirliliği - normların üzerinde üretim yan ürünleri ile dış ortamdaki değişikliklerin bir sonucu olarak ortaya çıkar. Kirletici unsurlar arasında katı, sıvı ve gaz halindeki maddeler, zararlı radyasyon bulunur. Ağır metaller (cıva, kurşun, kadmiyum), fosfatlar, nitratlar, kükürt oksitler, tarımsal zararlı ve hastalıklarla mücadelede kullanılan zehirli kimyasallar, iyonlaştırıcı radyasyon, radyoizotoplar, endüstriyel ve trafik gürültüsü daha zararlı kabul edilmektedir. Yukarıda belirtilen maddelerden bazıları mutajenik etki göstererek kansere neden olabilir. Şu anda, kirliliğin sıkı kontrolünün önemi insanlığın önünde ortaya çıkmıştır. Dış dolgularının içerdiği ağır metaller (gümüş, cıva, amalgam, nikel vb.) beyin ve sinir sistemi için (nöromusküler hastalıklar, otizm, dikkat eksikliği sendromu, depresyon vb.) endokrin sistem üzerinde patojenik bir etki. Şu anda, bazı ülkelerde amalgam kullanımı tamamen yasaklanmışken, bazı ülkelerde sadece hamile kadınlar için yasaklanmıştır.( Захарова H.A.,2014),

Kirlilik, yeni ve alışılmadık fiziksel, kimyasal ve biyolojik elementlerin herhangi bir ortama girmesi ve bu elementlerin ortamdaki miktarının artmasıdır. Kirliliğin doğrudan nesnelere, biyolojik topluluğun yaşadığı hava, su ve topraktır. Dolaylı kirlilik nesnelere kirliliğin kurbanlarıdır. Bunlar bitkiler, hayvanlar, mikroorganizmalardır. Çevre kirliliği, antropojenik aktivite sürecinde çeşitli maddelerin ve bileşiklerin atılması sonucu özelliklerinde zararlı yönde bir değişikliktir. Doğal çevrenin kirlenmesinin ana kaynağı, toplumun üretim ve yaşam faaliyetleri sürecinde ortaya çıkan büyük miktarlarda atığın bertaraf edilmesidir. Kirleticiler katı, sıvı ve gaz halindeki maddeleri, zararlı radyasyonu ve gürültüyü içerir. Ağır metaller (cıva, kurşun, kadmiyum), fosfat, nitrat, kükürt oksit, bitki ve hayvan zararlıları ile mücadelede kullanılan zehirli kimyasallar, iyonlaştırıcı radyasyon, radyoizotoplar, sanayi ve trafik gürültüsü daha zararlıdır.( Захарова H.A.,2014),

Kirliliğin kaynağı çok çeşitli olabilir. Bunlar arasında sadece sanayi işletmeleri ve termal enerji kompleksleri değil, aynı zamanda evsel, hayvancılık, ulaşım atıkları, ayrıca insanlar tarafından ekosistemlere getirilen kemirgen ve haşerelere karşı kullanılan maddeler de bulunmaktadır. Ekolojik açıdan kirlilik, sadece yabancı maddelerin havaya, toprağa ve suya atılması anlamına gelmez. Her durumda, kirlilik tüm ekosisteme zarar verir.( Мостовая B.B.,2007),Ek olarak, bir tür maddenin fazlalığı, ekolojik faktörlerin değişmesi anlamına gelir, çünkü zararlı maddeler aslında bu türdür. Bu nedenle, bu olduğunda, bu faktörlerin modu ve bileşimi, bunun veya başka herhangi bir organizmanın ekolojik tolerans sınırına karşılık gelmez. Bu durumda ekosistemdeki metabolizma bozulur, zararlı maddelerin doğal olarak çözünmesinde engeller ortaya çıkar.Çevre kirliliği karmaşık, çok yönlü bir süreçtir. Üretim atıkları daha önce olmadığı yerlerde ortaya çıkıyor. Çoğu kimyasal olarak aktiftir ve canlıların vücutlarındaki moleküllerle reaksiyona girer veya havada oksitlenir. Yaptıklarında canlılar için zehir olurlar.Kirliliğin sonuçları her zaman doğrudan kendini göstermez. Bu nedenle bilim adamları artık en erken aşamalarda kirliliğin derecesinin ne olduğunu arıyorlar.( Кәримова R.C., Vәliyeva Z.Y., Bayramov A. A., Әзизова Ә. N.,Әләкбәрова M. Q.,2022),

Ancak kirlilik sadece zararlı maddelerin çevreye salınması değildir. Örneğin, soğutma sistemlerinden gelen su doğal havzalara salındığında, oradaki doğal sıcaklık rejimi değişir. Bu sıcaklık kirliliğidir. Gürültü ve aydınlatma seviyesinin aşılması da kirlilik olarak kabul edilir.( Зербино Д.Д.,2009).Kirleticiler, aerosollerin yanı sıra metaller ve oksitler başta olmak üzere binlerce kimyasal ve toksik maddedir. Bu maddelerin farklı atık kaynakları olmasına rağmen, bileşim ve etkileri benzer olabilir. Böylece hidrokarbonlar, gaz ve petrol endüstrisinin atığı ve yanan yakıtın bir ürünü olarak havaya salınır.( Кәримова R.C., Vәliyeva Z.Y., Bayramov A. A., Әзизова Ә. N.,Әләкбәрова M. Q.,2022),Çevreye salınan veya normal miktarını aşan herhangi bir fiziksel varlık, kimyasal madde veya organizma (özellikle mikroorganizmalar) kirletici olabilir. Biyolojik süreçlerle parçalanmayan ve parçalanamayan antropojenik kirleticiler vardır. İlk önce doğal maddeler döngüye girer ve çevreden uzaklaştırılır veya diğer biyolojik maddeler içinde çözünür. İkincisi doğal olarak çözülmez. Bu nedenle vücuda girerler ve sindirilirler.( Керимова P.Дж., Гараев Г.Ш.,2017),Hava kirliliği, çeşitli gazların, buharların ve katı parçacıkların havaya salınması sonucu dünya atmosferinde meydana gelen istenmeyen herhangi bir değişikliktir. Bu, doğal süreçler veya insan faaliyetinin sonucu olabilir.Kirleticilerin yaklaşık %10'u atmosfere kül, tozlu asitler ve zehirli gazların salınmasıyla birlikte volkanik patlamalar gibi doğal afetlerle sonuçlanmaktadır. Deniz suyundan ve çürüyen bitkilerden gelen kükürt de atmosfere salınır. Orman yangınları sırasında atmosfere çok miktarda duman ve toz girer. Havadaki mikroorganizmalar (virüsler, bakteriler, mantarlar) insanların hastalıklara yakalanmasına ve çeşitli alerji formlarının yayılmasına neden olur.( Мостовая B.B.,2007).Yerdeki kirleticilerin geri

kalan %90'ı ise insan faaliyetleri sonucunda atmosfere karışmaktadır. Bunlar enerji santrallerinde ve arabalarda yakılan yakıtların duman ve toz emisyonları gibi araçlardır. Atmosfere salınan kirleticiler kaynaklarından ayrıştırılarak uzun mesafelere yayılır. Daha sonra yağmur, kar ve dolu ile karışarak katı parçacıklar, damlacıklar veya kimyasallar olarak yeryüzüne geri dönerler. Bu da diğer canlılar kadar insan sağlığını da olumsuz etkiler. (Зербино Д.Д., 2009).

Atmosfer kirliliği sanayi, ulaşım ve diğer üretim alanlarının faaliyeti sonucunda ortaya çıkmaktadır. Katı partiküller (aerosoller) ile birlikte, bu alanlar ayrıca atmosfere büyük miktarlarda zehirli gazlar salar. Atmosfere salınan maddeler arasında asit yağmurlarına neden olan kükürt dioksit (SO<sub>2</sub>) daha tehlikelidir. Bu tür yağışlar, yüksek endüstriyel gelişme ile karakterize edilen Avrupa, Kuzey Amerika, birçok Asya ülkesi ve Latin Amerika'da (Brezilya) yaygındır. Özellikle karbondioksit (CO<sub>2</sub>) başta olmak üzere atmosfere salınan sera gazları ciddi problemler. Kirlilik, kişinin fiziksel ve ruhsal durumu üzerinde olumsuz bir etkiye sahiptir. Havada, toprakta ve suda bulunan zararlı kimyasallar insan sağlığını tehdit ediyor. Ayrıca bağışıklık sistemini zayıflatırlar.

### **Kimyasallar sadece laboratuvarında kullanılmaz.**

Evde ya da işte zararlı maddelerle temas halinde olsak da onları önemsemeyiz. Örneğin aseton, boya, mürekkep, çeşitli yağlar vs. kullanıyoruz. Kimyasalların formları, insan vücuduna girme şekillerinde büyük farklılıklar yaratır. Örneğin: bir parça paslanmaz çelik, krom ve nikel gibi tehlikeli metalleri birleştirir. Katı formda, insanları etkilemezler. Ancak o demir parçasına kaynak yapılırken havaya salınan kaynak dumanları solunum sırasında akciğerlerimize rahatlıkla girebilmektedir. Kimyasal maddeler sağlığa zararları nedeniyle 3 ana gruba ayrılır:

Fiziko-kimyasal etkilere bakın - örneğin, oldukça yanıcı ve patlayıcı maddeler

Sağlık etkilerinden dolayı – örneğin toksik maddeler

Çevre üzerindeki etkilerinden dolayı - örneğin, su yaşamına zararlı maddeler

### **Kimyasallar genel olarak şu şekilde sınıflandırılır:**

Zehirli, Zararlı, Aşındırıcı, Tahriş edici, Kanserojen.

İnsan sağlığındaki hassaslaştırma işlevine göre kimyasallar iki kısma ayrılır:

Cilt hassaslaştırıcısı - bu tür kimyasallarla temas ettiğinde ciltte çeşitli dermatitler (cilt hastalıkları) görülür.

Solunum hassaslaştırıcı – Bu tür kimyasallar solunum sistemine girdiklerinde astıma neden olur

Kimyasal maddelere maruz kaldığında insanlarda etkisini iki şekilde gösterir: Akut - kısa bir süre yüksek dozda bir kimyasal maddeye maruz kaldığında, örneğin solunum organlarının tahrişi ve öksürme gibi etkilerini hemen gösterir. Kronik - az miktarda herhangi bir kimyasala maruz kaldığında, insan sağlığı üzerindeki etkisini uzun bir süre sonra (haftalar, aylar, bazen yıllar) gösterir. Örneğin birkaç kez asbeste maruz kalırsak ilk başta kendini göstermese de 10-20 gün sonra ciddi sağlık sorunları yaşarız.

### **Kimyasal bir maddenin insanı etkileme yolları:**

Kimyasalların insan vücuduna girmesinin 4 ana yolu vardır:

1. **Soluma** – Kimyasal burun veya ağız yoluyla alınır. Bu sırada solunum yollarında ve akciğerlerde tahrişe neden olur. İnsanlar nefes almak zorundaydı. Etrafta tehlikeli tozlar varsa, elbette insan vücuduna solunacaktır.

2. **Yutma yoluyla** - Bu sırada kimyasal madde ağız yoluyla alınır, emilir ve mideye girer ve ardından sindirim sistemine geçer. Bu tür erişim nadirdir. Çünkü normal bir insanın bilerek bir kimyasal maddeyi yutması ve yemesi pek olası değildir. Yutma, çoğunlukla yanlışlıkla veya kirli bir elin ağza alınmasıyla gerçekleşir.

3. **Deri yoluyla** - Kimyasal madde deri yoluyla girerek doku altına girer ve oradan kana geçer.

4. **Enjeksiyonla** – Bu durumda kimyasal, fiziksel bir enjeksiyon yoluyla derinin katmanlarından geçer. Örneğin, bir iğne ile, hasarlı bir cilt tabakası - kesikler ve yaralar yoluyla.

### **Kimyasalların insan hormon sistemi üzerindeki yıkıcı etkisi:**

Ev kimyasallarında ve endüstriyel ürünlerde kullanılan sentetik kimyasalların birçoğu insan hormon sistemi üzerinde yıkıcı bir etkiye sahip olabilmekte ve sağlık açısından ciddi olumsuz sonuçlara yol açabilmektedir. BM Çevre Programı (UNEP) ve Dünya Sağlık Örgütü (WHO) tarafından hazırlanan "Endokrin bozucu kimyasallar hakkında bilimsel bilgiler" adlı yeni bir rapor bu soruna ayrılmıştır. ( Керимова Р.Дж., Рзаева С.Дж., 2017) DST'nin halk sağlığı ve çevre departmanı direktörü Maria Neyra, "Endokrin bozucuların sağlık ve çevresel etkilerinin daha eksiksiz bir resmini elde etmek için acilen daha fazla araştırmaya ihtiyacımız var" dedi. Yeni bir rapora göre, endokrin bozucular olarak bilinen bazı maddeler hormonal sistemin işlevlerini değiştirebilir. Metabolizma, büyüme ve gelişme, uyku hali gibi işlevler için büyük önem taşıyan hormonların değişimini düzenleyen endokrin sistemin etkinliği insan sağlığı üzerinde belirleyici etkiye sahiptir. Bu tür kimyasalların doğal olarak bulunan bazı türlerinin yanı sıra böcek ilaçlarında, elektronik cihazlarda, kişisel hijyen ve kozmetik ürünlerinde çeşitli sentetik türleri bulunmaktadır. Gıda katkı maddesi olarak da kullanılırlar. Raporun yazarları, bu tür kimyasalların kadınlarda meme kanseri, erkeklerde prostat kanseri, erkeklerde sinir sistemi gelişimi ve tiroid kanseri için potansiyel bir risk kaynağı olduğu endişesini dile getiriyor. Tehlikeli kimyasallar çevreye çoğunlukla endüstriyel ve evsel atıklardan, tarımsal atıklardan ve ayrıca çöplerin yakılması ve bertaraf edilmesi sırasında girebilir. İnsanlar bu maddelere gıda ürünleri ve su tüketimi sırasında ve havayı solurken toz ve havadaki en küçük partiküllerin deriye düşmesi ile maruz kalabilmektedir. ( Керимова Р.Дж., Гулиева С.В., Халилов В.Г., 2014),

BM Genel Sekreter Yardımcısı ve UNEP İcra Direktörü Akhim Steiner, "Modern hayatımızda her geçen gün daha fazla kullanılan kimyasal maddeler, birçok ülkenin ulusal ekonomisinin önemli bir bileşenini oluşturuyor. Ancak kimyasalların yanlış yönetimi, kilit kalkınma hedeflerine ulaşılmasını ve herkes için sürdürülebilir kalkınmanın sağlanmasını zorlaştırıyor." Steiner, bağışçılardan yeni araştırmalar için fon ayırmalarını istedi. ( Мичурина С.В., Ефремов А.В., 2005). Rapor ayrıca, endokrin bozucuların vahşi hayvanlar üzerindeki etkisinin de ciddi endişe kaynağı olduğunu belirtiyor. Alaska'da (ABD), bu tür kimyasalların bazı geyik popülasyonları üzerindeki etkisi, bu hayvanların üreme fonksiyonlarının bozulmasına ve boynuzlarının deforme olmasına neden olabilir. Su samuru ve deniz aslanı popülasyonundaki düşüşler, bu tür maddelere, böcek ilaçlarına, diğer kalıcı organik kirleticilere ve cıva gibi metallerle maruz kalma nedeniyle de olabilir. Raporun baş editörü Stockholm Üniversitesi'nden Profesör Ake Bergman, "Son on yılda yapılan araştırmalar, endokrin bozukluklarının önceden düşünülenenden çok daha yaygın ve karmaşık olduğunu gösteriyor" dedi.

**Bulaşıcı olmayan endemik hastalıklar da vardır:** Bu tür hastalıklar o bölgedeki toprağın, suyun ve havanın kendine özgü bileşimi ile ilgilidir. Biyokimyasal durumla ilgili en yaygın hastalıklar arasında iyot eksikliğine bağlı endemik guatr, flor fazlalığına bağlı florozis, flor eksikliğine bağlı diş çürüğü ve demir eksikliğine bağlı anemi sayılabilir. ( Керимова Р.С., Рзаева С.С., Әзизова Ә.Н., İskəndərova Z.Ş., Байрамов А.А., Тəһмəзов Е.Ф., 2022) İyot insan vücudu için önemli bir eser elementtir. Su ve yiyeceklerden geçen insan vücudu için günlük iyot normu 0,05 mg'dır. Doğal sulardaki iyot miktarı yeterli değilse bu alanda yetiştirilen tarım ürünlerindeki iyot miktarı da düşük olacaktır. Sonuç olarak, insan metabolizması bozulur, gelişme gecikir ve ruh da bozulur. Ancak büyük şehirlerde içme sularındaki iyot miktarı yeterli olmasa da nüfus farklı bölgelerden getirilen ürünlerle beslediği için insanlarda endemik guatr hastalığı neredeyse görülmemektedir. Küçük yerleşim yerlerinde içme suyunda iyot yoksa önlem için iyotlanır sofrata tuzu kullanılması tavsiye edilir. ( Мичурина С.В., Ефремов А.В., 2005). Doğal kaynaklı hastalıkların önlenmesinin temel amacı, enfeksiyonun dolaştığı zincirdeki herhangi bir halkayı kırmaktır. Bunun için peyzajın iyileştirilmesi, toprağın uygun şekilde işlenmesi, mahsullerin zamanında hasat edilmesi, kemirgenlerin ve diğer virüs taşıyıcılarının zamanında yok edilmesi gerekir. Kişi, kendisini hastalıklardan koruyan tüm önleyici tedbirleri almalıdır. ( Зинчук В.В., Ходосовский М.Н., 2006), Ekosistemin düzenlenmesinde doğal faktörlerin etkisiyle mücadele etmek için insanın kendi yaşamını sürdürebilmesi için yapay bir ortam yaratmak üzere yeri doldurulamaz kaynaklar da dahil olmak üzere doğal kaynakları kullanmaya zorlandığı belirtilmelidir. Bu durumda, aşağıdaki faktörler hastalıkların ortaya çıkmasında büyük rol oynar: hipodinami, aşırı yeme, bilgi bolluğu, psiko-duygusal stres. Bu bağlamda, şu "yüzyılın hastalıkları" sürekli artmaktadır: kardiyovasküler, onkolojik, alerjik hastalıklar, ruhsal bozukluklar ve son olarak hızlanma vb. ( Керимова Р.С., İskəndərova Z.Ş., Әзизова Ә.Н., Рзаева С.С., 2022)

İnsanın ihtiyaçlarını karşılama çabası, onun çevre ile olan ilişkisini belirler. Organizmanın normal yaşam aktivitesi, iç ortamın bileşiminin nispeten sabit tutulmasıyla mümkündür. Talep, bir kişinin yaşam koşullarına bağlılığını gösteren bir durum olan bir faaliyet kaynağıdır.

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## OPTIMAL IMPEDANCE CONTROL OF A 2R PLANAR ROBOT MANIPULATOR

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### ABSTRACT

In this study, optimum impedance control of a 2R planar robot manipulator was performed. Industrial applications of robot manipulators are generally related to manipulation tasks such as painting that only require arm position control. However, there are other robotic tasks such as pushing, polishing, cleaning, and grinding that require interaction between the robot manipulator and a contact surface or environment. This fact makes it imperative to control the interaction between the robot and the environment. The impedance controller aims to control the dynamic relationship between the robot and the environment. The force applied by the robot to the environment depends on the position of the robot manipulator endpoint and the corresponding impedance. The impedance controller forces the robot to follow the desired reference or target impedance. Force task for force/position hybrid controller in literature; It is divided into two subspaces, the force control subspace, and the position control subspace. Then, two independent controllers are designed for each subspace. Conversely, the impedance controller proposed in this study does not attempt to explicitly control the force. Instead, it tries to control the relationship between the force and the position of the end effector in contact with the environment. It is also possible to plan a virtual trajectory such that a desired force profile is obtained when the environment has a rigid structure with known properties. The Bees Algorithm was used to optimize the proposed impedance controller and a numerical application was made to evaluate its performance. As a result of the optimization, the objective function was reduced by 57%. The obtained results are presented numerically and graphically. Thanks to the proposed impedance controller, the robot manipulator endpoint precisely follows both the desired force profile and the desired position.

**Keywords:** 2R planar robot manipulator, optimum impedance control, controller design, The Bees Algorithm.

### INTRODUCTION

Industrial applications of robot manipulators are generally related to manipulation tasks such as painting that only require arm position control [1-3]. The painting process can be done by spraying from a distance without the need for contact. Therefore, there is usually no need for force control. However, there are other robotic tasks such as pushing, polishing, cleaning, and grinding that require interaction between the robot manipulator and a contact surface or environment [4, 5]. Force based control techniques are well suited to this type of operation. One of these control techniques is impedance control. The impedance controller aims to control the dynamic relationship between the robot and the environment [6-8]. The force applied by the robot to the environment depends on the position of the robot manipulator endpoint and the corresponding impedance. The impedance controller forces the robot to follow the desired reference or target impedance.

Force task for force/position hybrid controller in literature; It is divided into two subspaces, the force control subspace, and the position control subspace [9, 10]. Then, two independent controllers are designed for each subspace. Conversely, the impedance controller proposed in this study does not attempt to explicitly control the force. Instead, it tries to control the relationship between the force and

the position of the end effector in contact with the environment. It is also possible to plan a virtual trajectory such that a desired force profile is obtained when the environment has a rigid structure with known properties.

The parameters of the impedance controller need to be optimized. Optimization algorithms are divided into two as global optimization algorithms and local search algorithms [11].

Global optimization algorithms such as Genetic Algorithm [12, 13], Particle Swarm Optimization [14] and The Bees Algorithm [15, 16] focus on searching across the entire space. Local search algorithms such as Hooke-Jeeves [17] and Newton Raphson [18] focus on searching in local areas. The Bees Algorithm was used to optimize the proposed impedance controller and a numerical application was made to evaluate its performance [19]. The obtained results are presented numerically and graphically. Thanks to the proposed impedance controller, the robot manipulator endpoint precisely follows both the desired force profile and the desired position.

### MATHEMATICAL MODEL

The robot has two degrees of freedom and consists of revolute joints. The system consisting of 2 linkages with masses  $m_1$  and  $m_2$  is shown in Figure 1.

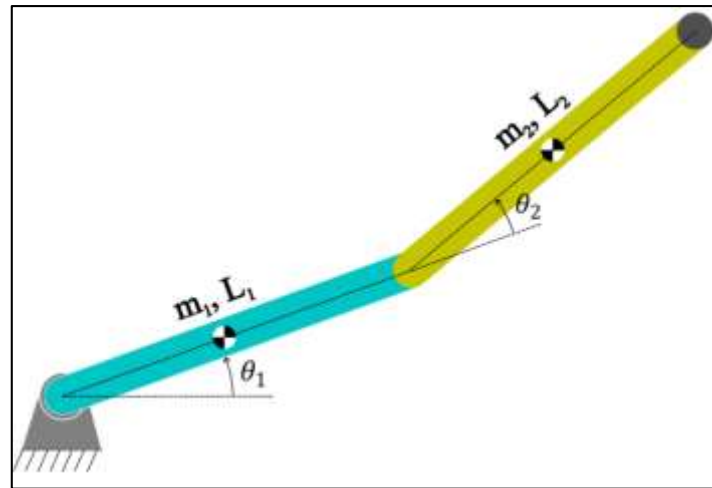


Figure 1. 2 dof robotic system

In order to derive the mathematical model of the system, the position of the centers of mass with respect to the joint angles must first be obtained. The center of mass position of the linkages with masses  $m_1$  and  $m_2$  according to the joint angles is shown in Equation (1).

$$\begin{aligned} \bar{x}_1 &= \frac{L_1}{2} \cos \theta_1 \\ \bar{y}_1 &= \frac{L_1}{2} \sin \theta_1 \\ \bar{x}_2 &= L_1 \cos \theta_1 + \frac{L_2}{2} \cos(\theta_1 + \theta_2) \\ \bar{y}_2 &= L_1 \sin \theta_1 + \frac{L_2}{2} \sin(\theta_1 + \theta_2) \end{aligned} \quad (1)$$

The mass moments of inertia of the rotation of the linkages around the center of mass are taken as  $I = \frac{1}{12} mL^2$ . The kinetic energy  $T$  of the system is given in Equation (2). The potential energy  $V$  is given in Equation (3).

$$T = \frac{1}{2} m_1 (\dot{\bar{x}}_1^2 + \dot{\bar{y}}_1^2) + \frac{1}{2} I_1 \dot{\theta}_1^2 + \frac{1}{2} m_2 (\dot{\bar{x}}_2^2 + \dot{\bar{y}}_2^2) + \frac{1}{2} I_2 (\dot{\theta}_1 + \dot{\theta}_2)^2 \quad (2)$$

$$V = m_1 g \dot{y}_1 + m_2 g \dot{y}_2 \quad (3)$$

Euler – Lagrangian equation of motion is used to obtain the equation of motion of the system. The Lagrangian expression for this is given in Equation (4).

$$L = T - V \quad (4)$$

The Euler – Lagrangian equation of motion applied to obtain the torque in the joints is given in Equation (5).

$$\tau_i = \frac{d}{dt} \left( \frac{\partial L}{\partial \dot{\theta}_i} \right) - \frac{\partial L}{\partial \theta_i} \quad (5)$$

The expansion of torques  $\tau_1$  and  $\tau_2$  is given in Equation (6).

$$\begin{aligned} \tau_1 = & \left( \frac{1}{3} m_1 L_1^2 + m_2 \left( L_1^2 + \frac{1}{3} L_2^2 + L_1 L_2 \cos(\theta_2) \right) \right) \ddot{\theta}_1 + m_2 L_2 \left( L_1 \cos(\theta_2) + \frac{2}{3} L_2 \right) \ddot{\theta}_2 \\ & - m_2 L_1 L_2 \sin(\theta_2) \left( \dot{\theta}_1 \dot{\theta}_2 + \frac{1}{2} \dot{\theta}_2^2 \right) + \frac{1}{2} (m_1 + 2m_2) g L_1 \cos(\theta_1) \\ & + \frac{1}{2} m_2 g L_2 \cos(\theta_1 + \theta_2) \\ \tau_2 = & \frac{1}{2} m_2 L_2 \left( L_1 \cos(\theta_2) + \frac{2}{3} L_2 \right) \ddot{\theta}_1 + \frac{1}{2} m_2 L_1 L_2 \sin(\theta_2) \dot{\theta}_1^2 + \frac{1}{3} m_2 L_2^2 \dot{\theta}_2^2 \\ & + \frac{1}{2} m_2 g L_2 \cos(\theta_1 + \theta_2) \end{aligned} \quad (6)$$

### IMPLEMENTATION OF IMPEDANCE CONTROL

The impedance control schematic is shown in Figure 2. Impedance control requires forward kinematics and inverse dynamics equations of the point where the robot is desired to interact, using the joint angles. The distance between the position obtained with forward kinematics and the desired position is converted into interaction force by multiplying the spring and by multiplying the velocity with the damping coefficients. It is then multiplied by the transpose of the Jacobian matrix and converted into torques at the joints. These torques are added to the torques found by inverse dynamics to obtain a final torque. This torque is sent to the robot and control is provided.

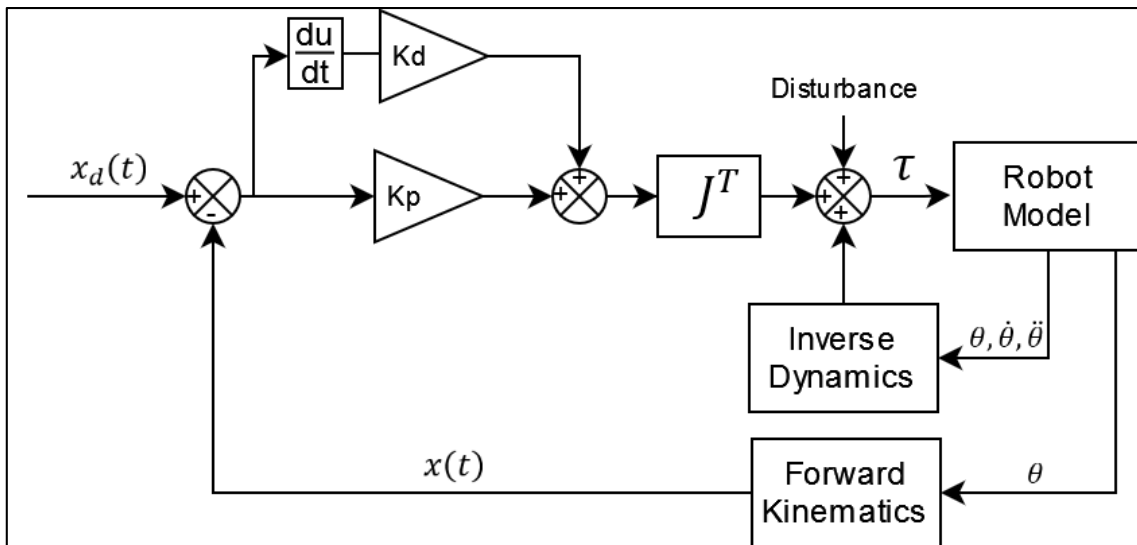


Figure 2. Impedance control

The PID-based interaction force is given in Equation (7).

$$F_{int} = k \begin{bmatrix} x_{2d} - x_2 \\ y_{2d} - y_2 \end{bmatrix} + b \begin{bmatrix} \dot{x}_{2d} - \dot{x}_2 \\ \dot{y}_{2d} - \dot{y}_2 \end{bmatrix} + i \int \begin{bmatrix} x_{2d} - x_2 \\ y_{2d} - y_2 \end{bmatrix} dt \quad (7)$$

The spring coefficient of the impedance controller is defined as  $k$ , the damping coefficient  $b$ , and the integral gain  $i$ .  $x_{2d}$  and  $y_{2d}$  are the targeted location of the robot's endpoint.  $x_2$  and  $y_2$  are the actual position of the robot's endpoint. The position of the end point of the robot is given in Equation (8).

$$\begin{aligned} x_2 &= L_1 \cos \theta_1 + L_2 \cos(\theta_1 + \theta_2) \\ y_2 &= L_1 \sin \theta_1 + L_2 \sin(\theta_1 + \theta_2) \end{aligned} \quad (8)$$

In order for the interaction force in Equation (7) to be converted into torques, it is necessary to multiply it by the Jacobian matrix of the robot endpoint. The Jacobian matrix of the system is given in Equation (9).

$$J = \begin{bmatrix} \frac{dx_2}{d\theta_1} & \frac{dx_2}{d\theta_2} \\ \frac{dy_2}{d\theta_1} & \frac{dy_2}{d\theta_2} \end{bmatrix} \quad (9)$$

$$J = \begin{bmatrix} -L_1 \sin(\theta_1) - L_2 \sin(\theta_1 + \theta_2) & -L_2 \sin(\theta_1 + \theta_2) \\ L_1 \cos(\theta_1) + L_2 \cos(\theta_1 + \theta_2) & L_2 \cos(\theta_1 + \theta_2) \end{bmatrix}$$

The impedance torques obtained by multiplying the interaction forces with the transpose of the Jacobian matrix are given in Equation (10).

$$\tau_e = J^T F_{int}$$

$$\tau_e = \begin{bmatrix} -F_x(L_1 \sin(\theta_1) + L_2 \sin(\theta_1 + \theta_2)) + F_y(L_1 \cos(\theta_1) + L_2 \cos(\theta_1 + \theta_2)) \\ -F_x L_2 \sin(\theta_1 + \theta_2) + F_y L_2 \cos(\theta_1 + \theta_2) \end{bmatrix} \quad (10)$$

In Equation (10), the x component of the  $F_{int}$  force is  $F_x$  and the y component is  $F_y$ . The final torques are the sum of dynamic torques in Equation (6) and the impedance torques in Equation (10).

### NUMERICAL APPLICATION

$L_1 = L_2 = 1$  m and  $m_1 = m_2 = 5$  kg. Figure 3 shows the path followed by the scenario. The BC plane is 1 m away from the first joint of the robot and is at a  $65^\circ$  inclination with the ground. The endpoint of the robot first moves from point A to point B. It then proceeds from point B to point C by applying a force of 50 N to the BC plane.

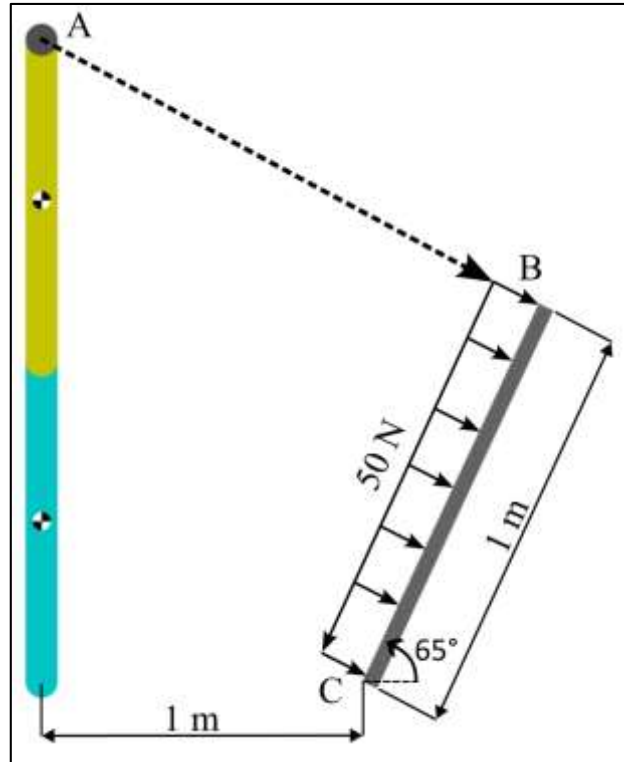


Figure 3. Numeric application view

In order for the robot to apply 50 N perpendicular to the surface while its tip point moves in the BC plane, the 50 N force at a  $90^\circ - 65^\circ = 25^\circ$  inclination from the robot's tip point to the ground is added to the interaction force seen in equation (11).

$$F_{int,modified} = F_{int} + 50 \begin{bmatrix} \cos(25^\circ) \\ \sin(25^\circ) \end{bmatrix} \quad (11)$$

The objective function used to optimize the k, b and i coefficients in Equation (7) is defined in Equation (12).

$$f_{obj} = \int_{t_1}^{t_2} (x_{2d} - x_2)^2 + (y_{2d} - y_2)^2 + (F_n - 50N)^2 \quad (12)$$

$F_n$  is the reaction force of the BC plane against the robot endpoint.  $t_1$  is the first contact time of the robot's endpoint to point B.  $t_2$  is the time when the robot endpoint reaches point C.

The objective function is obtained by squaring the distance error and the difference of the surface reaction force from 50 N. By minimizing this objective function, both the distance error will be reduced, and the surface reaction force will be approached to 50 N.

### THE BEES ALGORITHM

The algorithm starts with n scout bees being placed randomly in the search space. The fitness of the population is calculated; this means the error of all the scout bees are calculated. The array of the scout bees is reordered from minimum error to maximum error. The best m sites are selected to be search for neighborhood search. The next bees will search those sites within the radius of patch size which is ngh. But more scout bees will be sent to elite sites which are shown as number e. The remaining scout bees are less than the number of elite bees. Each site is reordered from minimum error to maximum error. In addition, the fittest bee is selected for that site. The remaining (n-m) bees are replaced with the new randomly created bees. The fitness of the new population is recalculated, and the loop continues until

the stop condition occurs. The pseudo code for The Bees Algorithm in its simplest form is:

1. Initialize population with random solutions.
2. Evaluate fitness of the population.
3. While (stopping criterion not met)
4. Select sites for neighborhood search.
5. Recruit bees for selected sites (more bees for best e sites) and evaluate fitness.
6. Select the fittest bee from each patch.
7. Assign remaining bees to search randomly and evaluate their fitness.
8. End While

The Bees Algorithm is shown in Figure 4.

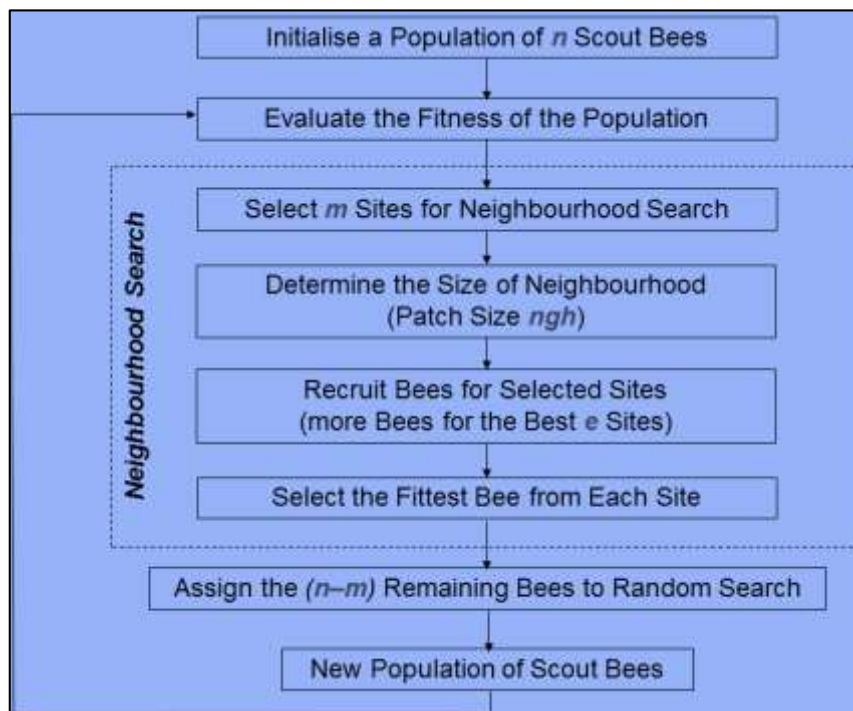


Figure 4. The Bees Algorithm

The parameters of The Bees Algorithm are given in Table 1.

Table 1. The Bees Algorithm parameters

<b>n</b>	<b>m</b>	<b>e</b>	<b>nep</b>	<b>nsp</b>	<b>ngh</b>	<b>p<sub>max</sub></b>	<b>p<sub>min</sub></b>
10	7	4	5	3	0.1	[30,5,5]	[0,0,0]

## RESULTS AND DISCUSSION

The result of the optimization made with The Bees Algorithm is given in Table 2. The optimization is completed with 18243 iterations. As a result of the optimization made from a randomly generated starting point, the objective function decreased by 57% compared to the initial condition.

Table 2. The Bees Algorithm parameters

	Initial Conditions	The Bees Algorithm Result	Change
$k$	25	25.10477514	+0.41%
$b$	3	2.416703157	-19.44%
$i$	0	0.541278214	+0.54
$f_{obj}$	11.09625654	4.771782226	-57%

The convergence graph during the optimization of the objective function is shown in Figure 5.

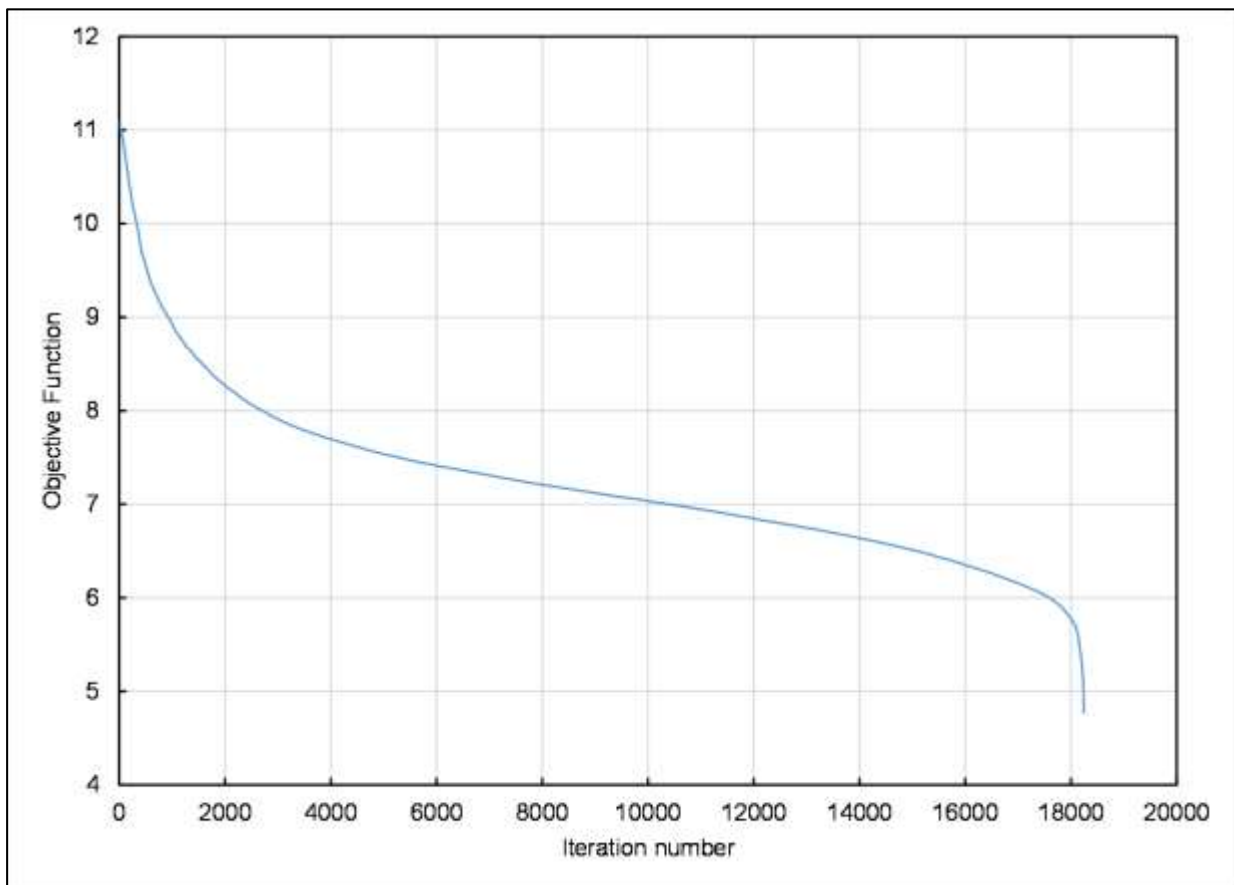


Figure 5. Convergence graph of the objective function.

The positions of the robot during the scenario are shown in Figure 6.



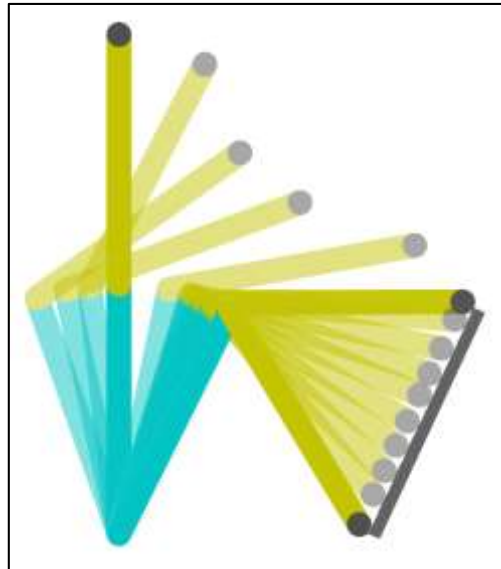


Figure 6. Movement of the robot in space and on the plane

The robot touches the BC plane at the 5<sup>th</sup> second. According to the scenario 50 N force must be applied on the surface and robot's endpoint must move from point B to C. From 5<sup>th</sup> to 7<sup>th</sup> second, robot's endpoint pushes on the BC plane until the reaction force is 50 N. From point B to point C, robot's endpoint moves while applying 50 N on the plane. The force change is shown in in Figure 7.

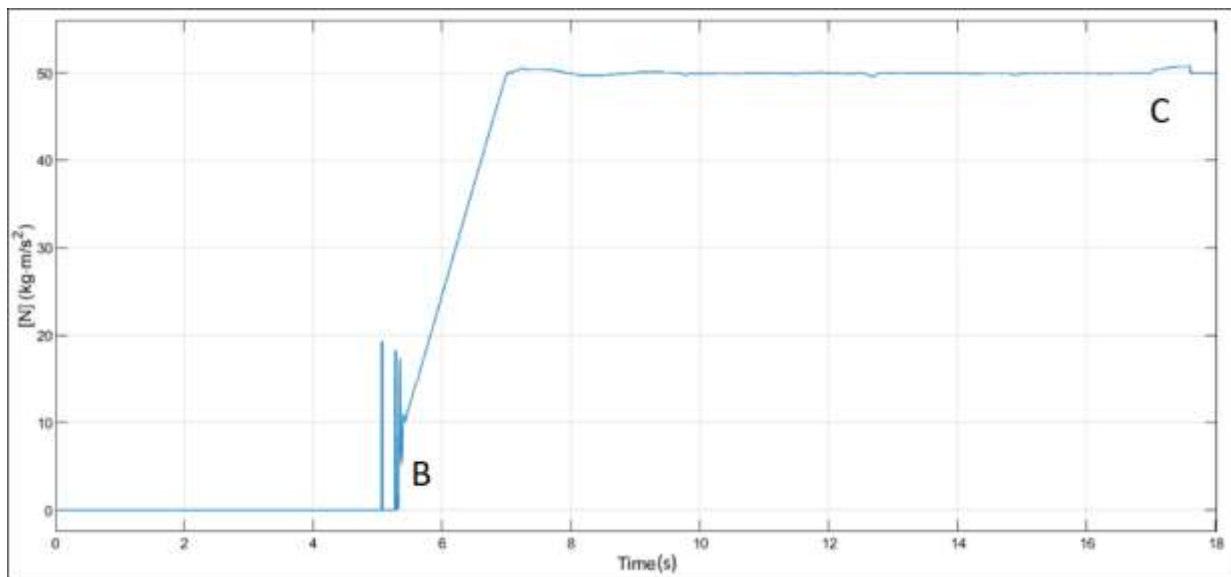


Figure 7. The reaction force of the plane during the movement of the robot

The reaction force of the BC plane to the endpoint of the robot ranges from 49.5 N to 50.8 N. The desired force of 50 N is applied within -1% and +1.6%.

In Figure 8, the desired positions are  $x_d$  and  $y_d$ , and the actual positions are seen as  $x_2$  and  $y_2$ . As seen in the figure, actual positions are very close to desired locations.

The interaction distance at the endpoint of the robot is given in Figure 9.

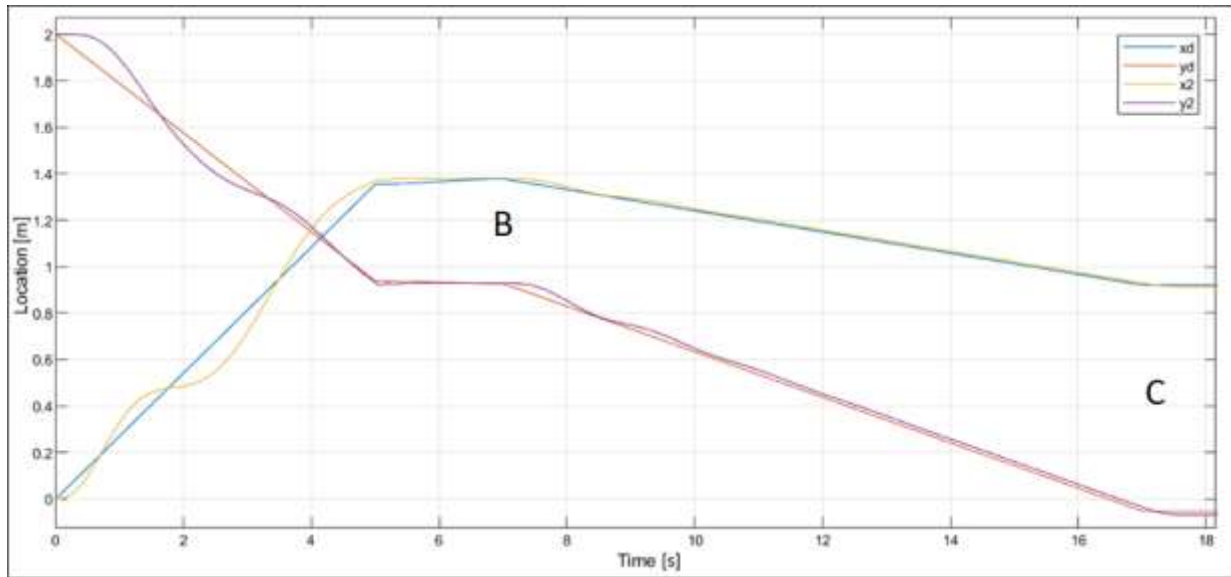


Figure 8. Desired and actual locations of the robot's endpoint.

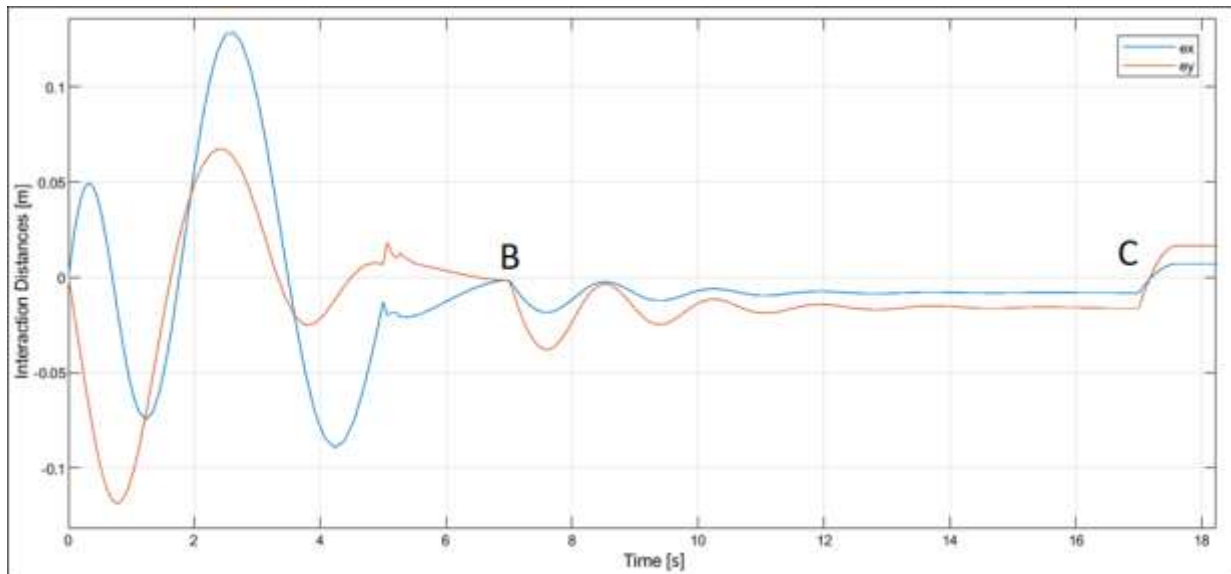


Figure 9. Interaction distances at the robot endpoint

Accordingly, while there are very large interaction distances before the contact with the BC plane, that is, before the 5<sup>th</sup> second, it is seen that the interaction distances are less when applying 50 N on the BC plane, that is, after the 5<sup>th</sup> second.

## CONCLUSIONS

In this study, the position of the endpoint of a 2 dof robot was controlled using the impedance control technique. In addition, during the movement of the robot's end point on a plane, a change was made on the impedance force to apply a workload such as 50 N. During this movement, the workload is applied with an error between -1% and +1.6%.

In addition, the impedance controller parameters are optimized with The Bees Algorithm. As a result of the optimization made with a randomly determined initial condition, an improvement of 57% was achieved and the optimization was completed.

In this study, it has been shown that a force can be applied in a desired direction while the end point of the robot moves on a trajectory using the impedance control technique. In future studies, the change in desired position can be studied instead of changing the interaction force in this study.

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**EFFECT OF THE HOLE POSITION OF VACUUM PLATE ON SEED SPACING  
UNIFORMITY PERFORMANCE OF PNEUMATIC PRECISION VEGETABLE SEEDERS\***

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**ABSTRACT**

The objective of this study was to determine the seed releasing characteristics of seed metering discs used in the precision seeding of black carrot seeds. High precision vegetable seeder was tested in the field conditions using black carrot seeds in Ereğli-Konya. Three different seed metering discs that have holes in three different circle positions were used in the experiments. These applications referred to seeding techniques, ST1, ST2, and ST3. The vacuum plates with three circles, each circle diameter was Ø210 (P1), Ø 185 (P2), and Ø 155 (P3) mm respectively and the number of holes was 96 on these three circles of ST1, for ST2 96, 96 and 72, for ST3 96, 96 and 48 respectively. The downforce on the gauge wheel was kept constant throughout all trials. These experiments were sown at three different sowing distances with three discs at the same ground speeds. The performance indicators of precision seeders investigated were multiple, miss index, quality of feed index and also precision values. According to the results, the emergence rates of the ST3 were higher and the coefficient of variation values was lower. Since the seeds leave from the P3 hole position and are delivered to the vertical seed slide of the runner opener, this situation has contributed positively to the planting quality. It is essential that use a pneumatic precision vegetable seeder with two or three units (row independent) seeders in narrow row spacing. Therefore, domestic row-independent type pneumatic precision seeder production should be supported.

**Key words:** seed metering unit, vacuum plate, seed distribution uniformity, vacuum type precision vegetable seeder, black carrot seeds

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## INVESTIGATION OF THE EFFECT OF TEMPERATURE ON THE ENERGY PRODUCTION FOR PHOTOVOLTAIC PANELS

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### ABSTRACT

Photovoltaic (PV) panels in solar power plants are excited by photons from the sun. Due to this excitation, the amount of electrons in the semiconductor increases with high temperature. This situation causes both a decrease in the voltage that PV panels can produce and a decrease in the efficiency of the system output. In other words, it is observed that the power output of the panel decreases at a temperature above the optimum temperature, and increases in the opposite case. For this reason, it is necessary to examine the effect of temperature on efficiency. In this study, the instant data of the remote monitoring system is obtained from the roof SPP located in the Rail Systems Yeşilyurt Metro Station of the Adana Metropolitan Municipality, and the effect of the temperature on the efficiency is proposed to examine. In this context, the effect of panel temperature on energy is determined by taking into account the temperature coefficient of the maximum power output point. Moreover, it is calculated how much energy can be produced above the optimum temperature level according to 1/°C unit, which is temperature coefficient. In addition, a (high sensitivity) PT1000 RTD sensor is used to measure the panel temperature values. It is thought that this work will lead to future studies in terms of the energy production efficiency calculation of the PV panels in the facilities that are actively in operation and continue to produce energy will be made in real time against the panel temperature.

**Keywords:** Solar power plants, photovoltaic panels, panel temperature, efficiency, sensor.

### INTRODUCTION

Photovoltaic (PV) panels located in solar power plants, which are based on solar cells, are designed according to semiconductor materials to convert the energy from the sun into electrical energy. As soon as the radiation from the sun hits the panel surface, the photons from the sun create a charge in each cell and thus the electrons in the semiconductor material are excited to a higher energy level. As a result of this formation, unidirectional electric flow occurs and this phenomenon is known as the photoelectric effect. On the other hand, at temperatures above the optimum operating temperature, the amount of electrons in the semiconductor increases as the PV panels are excited by photons from the sun. This reduces the voltage that PV panels can produce, causing a decrease in efficiency. In other words, less energy is produced than the amount of energy that needs to be produced, and less power output is provided than the output of PV panels. In addition, high temperatures cause a negative effect on DC/AC conversion electronic circuits, causing an increase in resistance on these circuits [1].

In solar power plants connected to the grid, energy losses occur because PV inverters fail for various reasons [2-4]. Operating at higher temperatures required for the PV panel is one of the reasons for these losses [5] It is seen that many studies have been carried out in the literature to eliminate energy losses due to temperature [6]. Flicker conducted a study to show that units exposed to high thermal and electrical stress affect PV inverters [7]. In another study by Chan et al., it was emphasized that high temperature is a possible cause of failure in single-phase PV inverters [8]. Chander et al. used a solar simulator to examine the effect of PV cell temperature. Thanks to this simulator, it varies under constant light intensities. Because they stated that the locations change depending on the special climatic conditions and these locations rarely provide the real sun conditions. In their study, they controlled the

PV cell temperature by accepting the temperature coefficients of  $V_{oc}$ ,  $P_{max}$  and filling factor (FF) as negative and the  $I_{sc}$  value as positive [9]. In addition, Dash and Gupta stated in their study that temperature affects the output power of PV panel types. In this study, they observed that the highest loss was experienced at an average output power of  $-0,446\%/^{\circ}C$  [10]. A study showing that high temperatures cause power loss in PV panels was also done by Temaneh-Nyah and Mukwekwe. In their study, they implied that a 37.8 kW PV system installation experienced a power loss of 0.31% per Kelvin due to increased temperature. Amelia et al. also evaluated the output performance of the panels by examining the effect of temperature on PV [11]. For this evaluation, the PV panel model was simulated using the PV syst software. The thermal distribution was analyzed with the measured panel temperatures. As a result, they stated that in case of excessive temperature increase, the output power of the PV panel decreases and the efficiency increases [12].

Unlike the studies mentioned above, for the first time in this study, the temperature coefficient of the maximum power output point is taken into account, and it is calculated how much energy can be produced above the optimum temperature level of the panel temperature. In this way, the energy production efficiency calculation of the PV panels in the facilities that continue to actively produce energy will be made in real time against the panel temperature. This paper contains four sections as follows:

The details on a panel output power depending on temperature is described in Methods and Materials Section. Moreover, the remote monitoring system of the solar power plant, from which temperature data is obtained, is introduced in this section. The comparison of the obtained panel temperature data with the parallel energy production data is discussed in Experimental Results section. In addition, the results obtained are presented too. Lastly, the paper is concluded in the last section called as Conclusion Section.

## METHODS AND MATERIALS

### The Temperature Dependent Panel Output Power of The PV Module

The panel output power ( $P_{out}$ ) of the PV module is correlated with the Panel rated power at STC ( $PRP$ ), solar radiation amount ( $SRA$ ), solar radiation amount in STC ( $SRA_{ref}$ ), temperature coefficient of the maximum output power ( $T_c$ ), panel temperature ( $P_T$ ) and the panel temperature at STC ( $P_{T-ref}$ ). The correlation defining the panel output power of the PV module can be calculated by using given equation in Eq. 1. [13].

$$P_{out} = PRP * \frac{SRA}{SRA_{ref}} [1 + T_c(P_T - P_{T-ref})] \quad (1)$$

Here, the  $SRA_{ref}$  is given as 1000 W/m<sup>2</sup> and  $T_c$  is taken as  $-0.42\% 1/^{\circ}C$ .

Various types and efficiency PV panels are used in solar power plants. In general, the operating temperature of a typical PV panel is accepted as 25°C according to international organizations and naturally panel manufacturers. It is generally declared as 25°C as STC on the labels of PV panels. This value is accepted as industrial value. The decrease in energy production above this temperature is expected to decrease depending on the radiation intensity.

There are some differences in the level of power reduction according to the characteristics of the PV panels used in solar power plants. PV panel manufacturers perform various tests during the production phase to determine the characteristics of the panels, and one of the results of these tests is to determine the temperature coefficient of the maximum power output point. According to the temperature coefficient, the amount of energy that can be produced above the optimum temperature level is calculated according to the 1/<sup>o</sup>C unit. Therefore, it is possible to calculate the energy efficiency. The linear expression for the PV electrical efficiency ( $\eta_c$ ) can be given in Eq. 2. [14].

$$\eta_c = \eta_{Tref} [T_c(P_T - P_{T-ref})] \quad (2)$$

where  $\eta_{T_{ref}}$  is defined as the electrical efficiency at the reference temperature.

### **The Outdoor Experimental Setup**

In the study, the rail systems in Adana were carried out by taking data from the remote monitoring system of the 60kW commercial roof type solar power plant located on the Yeşilyurt station. In Fig.1, the photographic view of the roof type solar power plant used in outdoor conditions is given.



Figure 1: The photographic view of the roof type solar power plant

According to IEC 61724-1, the data provided by the high-precision PT1000 1/3 Class B type panel temperature sensor are obtained by collecting data for a total of 6 days, taking data every 5 minutes over the remote monitoring system between 01.12.2022 and 06.12.2022.



Figure 2: The used panel temperature sensor

### **EXPERIMENTAL RESULTS AND DISCUSSIONS**

In this study, data were recorded using the remote monitoring system of the 60kW commercial rooftop solar power plant located on the rail systems Yeşilyurt station in Adana. These data are modulated temperature sensor datas, energy production datas and irradiance datas respectively. While the datas were recorded at each hour ( 08:00-17:00), these data were taken for 6 days between 01.12.2022 and 06.12.2022.



**Table 1.** Module Temperature Sensor Data

<b>Module Temperature Sensor Data (°C)</b>						
	<b>1.12.2022</b>	<b>2.12.2022</b>	<b>3.12.2022</b>	<b>4.12.2022</b>	<b>5.12.2022</b>	<b>6.12.2022</b>
<b>08:00</b>	16.1	14.7	13.3	12.5	12.9	12.9
<b>09:00</b>	17.3	16.2	16.3	15.8	15.9	15.4
<b>10:00</b>	20.8	18.9	18.3	20.6	17.6	19.9
<b>11:00</b>	21.4	21.6	21.4	22.3	20.9	20.3
<b>12:00</b>	22.7	24	23.4	24.7	23.5	22.6
<b>13:00</b>	22.4	24.4	24.6	24.9	24.1	21.9
<b>14:00</b>	25.9	23.3	25.7	26.8	24.1	20.9
<b>15:00</b>	21.6	22	21.4	22.3	21	19.8
<b>16:00</b>	21.5	21.4	21.7	21.8	20.7	19.6
<b>17:00</b>	20.8	20.1	20.3	20.3	19.9	18.8

In Table 1, the datas related with module temperature sensor are given. As can be seen from the table, the minimum recorded temperature value is 12.5 (°C) while the maximum is 26.8 (°C). The temperature values do not show a linear increase or decrease. A variable temperature data is obtained.

**Table 2.** Energy Production Data

<b>Energy Production Data (kWh)</b>						
	<b>1.12.2022</b>	<b>2.12.2022</b>	<b>3.12.2022</b>	<b>4.12.2022</b>	<b>5.12.2022</b>	<b>6.12.2022</b>
<b>08:00</b>	0.8	0.5	0.6	0.5	0.6	0.4
<b>09:00</b>	5	4.6	4.8	4.5	5	4.4
<b>10:00</b>	18.4	17.4	18.1	17.1	18.3	16.8
<b>11:00</b>	36.6	37.4	39.1	38	39.3	37.9
<b>12:00</b>	57.6	61.9	64.3	63.4	65.6	62
<b>13:00</b>	76.7	87.1	90.8	90.3	93.3	86.1
<b>14:00</b>	93.6	108.1	112.4	112.1	114.3	103.7
<b>15:00</b>	100.1	116.3	120	119.6	121.9	112.5
<b>16:00</b>	106.3	122.8	124.9	124.2	127	118.2
<b>17:00</b>	108.8	125.9	127.5	126.1	129.7	121.2

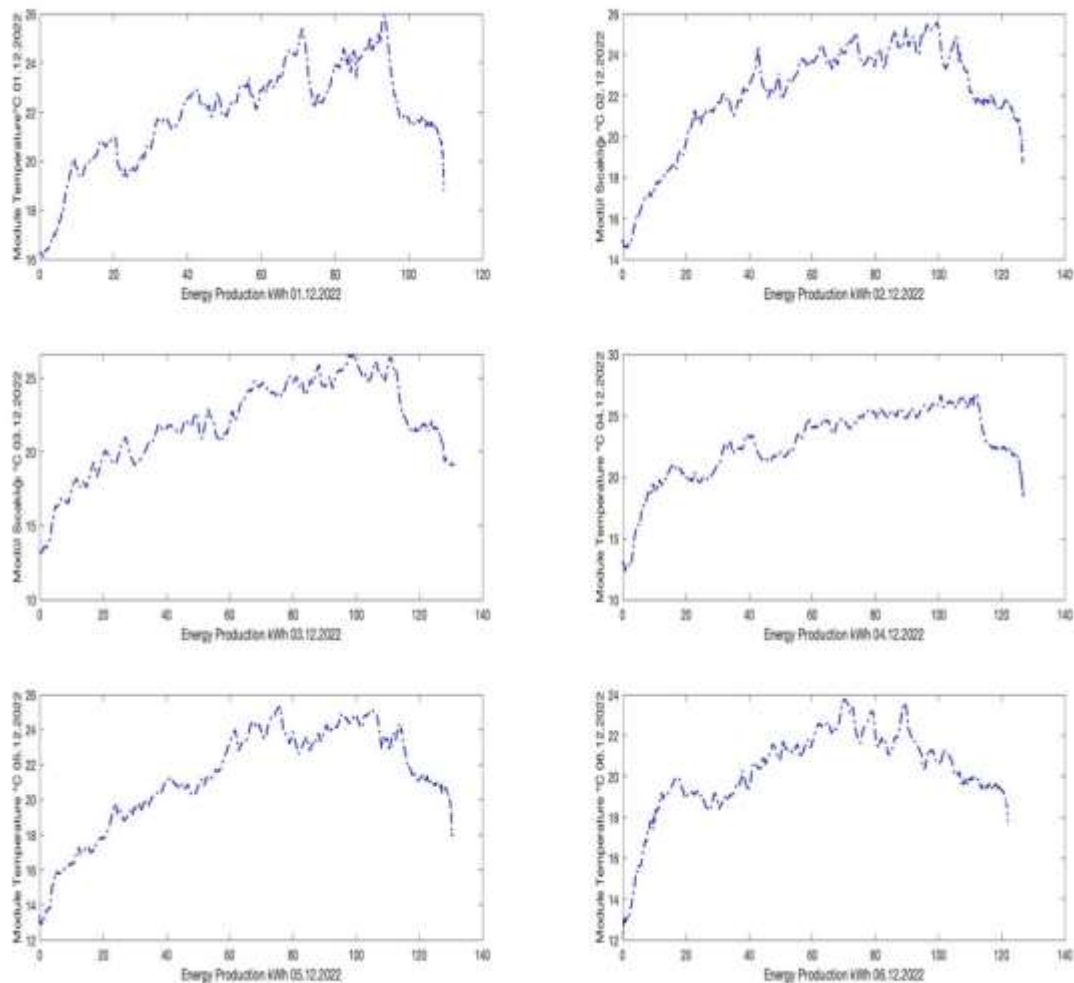
The second data obtained from the system within the scope of this study is the energy production data. In Table 2, it can be clearly seen that the energy production data recorded daily and every hour do not vary in direct proportion to the temperature.

**Table 3: Irradiance Data**

<b>Irradiance Data (W/m<sup>2</sup>)</b>						
	<b>1.12.2022</b>	<b>2.12.2022</b>	<b>3.12.2022</b>	<b>4.12.2022</b>	<b>5.12.2022</b>	<b>6.12.2022</b>
<b>08:00</b>	39	14	19	17	22	17
<b>09:00</b>	101	230	244	243	241	208
<b>10:00</b>	222	359	382	375	381	379
<b>11:00</b>	549	424	440	444	472	454
<b>12:00</b>	226	425	424	442	471	405
<b>13:00</b>	395	364	366	381	383	268
<b>14:00</b>	220	229	218	206	176	157
<b>15:00</b>	75	86	52	51	61	77
<b>16:00</b>	48	58	34	31	41	53
<b>17:00</b>	10	15	12	10	13	17

In Table 3, the value of irradiance received per hour is presented. The highest irradiance value was obtained as 549 in line with the data obtained on the first day. The lowest irradiance value was recorded as 10 at the end of the 4th day.

Using the values in the tables given above, the module temperatures versus energy production graphs were produced. These graphs are implemented by using MATLAB program, which has been run via Microsoft Windows XP professional with CPU 2.00 GHz and Intel Core 2 Duo. The graphs of module temperatures versus energy production are depicted in Figure 3.



**Figure 3.** The graphs of module temperatures versus energy production

In this study, different temperature values from the ambient temperature data were observed in the panels with the effect of temperature and ambient temperature caused by semiconductor energy production. It is seen in the tables and graphs that this temperature is negative for the energy production of the panel at optimum temperatures and above other optimum parameters. During this experimental study, instantaneous irradiance values and other environmental parameters were observed. One of the biggest factors affecting the energy production negatively is the panel temperature value, which was calculated as a result of the experimental data. It has been observed that another negative factor in energy production is dusting and contamination on the surface of the panels. In future studies, it will be studied to detect such environmental factors with silicon-based optical sensors.

## CONCLUSION

Today, energy independence is a priority for our country. In this direction, it is desired to obtain energy from alternative energy sources both in our country and in the world. This is the desire to have energy diversity and alternative sources. Although it seems easy in practice to obtain electrical energy from photovoltaic panels, the issue of energy efficiency turns out to be an issue that needs to be emphasized. Contrary to what is known, it is not a correct idea that more energy can be obtained at high temperatures. There are various environmental factors that affect efficiency while obtaining energy from photovoltaic panels. The temperature of the environment where the facility is located, humidity, wind speed, environmental factors that will cause dust will have a negative effect on energy production unless they

are at optimum levels. We have seen in this study that the ambient temperature and the temperature of the panels are not the same. The panels give more power output at high irradiance values but below the reference temperature value.

The increase in the temperature of the panels has a negative effect on the efficiency of the plant. This situation should be taken into consideration while making the facility projects and cooling process should be done on the panels. Performing cooling operation at the location of the facility or above undesirable temperature values will increase the efficiency and energy output of the facility.

#### **ACKNOWLEDGMENT**

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**BIOGENIC SYNTHESIS OF SILVER NANOPARTICLES USING LEAF EXTRACTS OF  
*CHROMOLAENA ODORATA*, *TITHONIA DIVERSIFOLIA*, AND *SOLENOSTEMON  
MONOSTACHYUS*.**

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**ABSTRACT**

Silver nanoparticles (AgNPs) have gained the interest of different field of sciences due to their versatile application in daily activities. The use of more sustainable and eco-friendly approach is required to promote synthesis. To emphasise an alternative approach which is save, economical and eco-friendly, this research has demonstrated the use of leaf extracts of *Chromolaena odorata* (CO), *Tithonia diversifolia* (TD), and *Solenostemon monostachyus* (SM), for biogenic synthesis of silver nanoparticles. The resultant colour changes indicating the synthesis of AgNPs were brown, yellow, and brown respectively. The AgNPs were characterized through UV-Vis spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), and Transmission Electron Microscopy (TEM). The UV-Vis spectrum from this work showed a strong absorption peak at 445 nm, 437 nm, and 430 nm for AgNPs mediated synthesis using leaf extracts of CO, TD, and SM respectively. Synthesized AgNPs were predominantly spherical in morphology with triangular and rod like shape also identified in CO AgNPs, with an average size of 27.48nm, 49.64nm, and 25.76nm for synthesized AgNPs using CO, TD, and SM respectively. The FTIR spectra of the reduced silver nanoparticles has absorption bands at 1637.99  $\text{cm}^{-1}$ , 2062.27  $\text{cm}^{-1}$ , and a broad peak between 3230.61  $\text{cm}^{-1}$  to 3601.06  $\text{cm}^{-1}$  for CO; 1641.16  $\text{cm}^{-1}$ , 2062.27  $\text{cm}^{-1}$ , and a broad peak of 3230.61  $\text{cm}^{-1}$  – 3629.55  $\text{cm}^{-1}$  for TD; 1637.99  $\text{cm}^{-1}$ , 2059.10  $\text{cm}^{-1}$ , and 3487.07  $\text{cm}^{-1}$  for SM, indicating that carbonyl stretch of amides and stretching vibration of O–H functional group are important in the bio-reduction of  $\text{AgNO}_3$  to AgNPs and subsequent capping and stabilization.

**Keywords:** Silver Nitrate, Silver Nanoparticles, Eco-friendly, UV-Vis, FTIR, TEM

**DESIGN NOVEL POTENTIAL EGFR INHIBITORS USING 2D QSAR, ADMET  
PREDICTION, OSIRIS, MOLINSPIRATION, MOLECULAR DOCKING AND  
MOLECULAR DYNAMIC SIMULATION**

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**ABSTRACT**

The objective of this research was to conduct a 2D-QSAR experiment on a series of 34 dimedone-derived molecules with biological inhibitory activity against human colon cancer (HT-29). Based on principal component analysis (PCA), multiple linear regression (MLR), multiple non-linear regression (MNL) and artificial neural network (ANN). According to the evaluations of these QSAR models, their predictive power is high ( $R^2(\text{RLM}) = 0.884$ ;  $R^2\text{CV}(\text{RLM})$ 's reliability was tested internally, externally, Y-randomized and across domains. Four molecular structures are designed using the QSAR model predictions. As a result of model-based drug discovery, we were able to identify four molecules that were significantly more potent than 34 other compounds that had been tested against HT-29 human colon cancer cells. Using ADMET, Molinspiration, and Osiris as inputs, we tested the four compounds' ADMET predictions. Nevertheless, only one designed compound respects all the Osiris properties, despite excellent ADMET predictions and molinspiration. The newly designed molecule C was docked with the c-met protein using molecular docking. In c-met, the newly designed compound exhibits high stability. Based on the MD results, compound C appears to be a promising c-met agonist. The investigated compound has the potential to lead to new drugs that target c-met, based on our results.

**Key words:** Dimedone, Colon cancer cells, QSAR, Osiris, Molinspiration, ADMET, Molecular Docking and dynamics

**ANTIUREASE EFFECT OF BENZENESULFONOHYDRAZIDES, IN VITRO AND IN SILICO STUDIES**

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**ABSTRACT**

Keeping in view the therapeutic importance of ureases due to its involvement in different pathological conditions, its inhibition was investigated by newly synthesized benzenesulfonohydrazides. Elemental analysis, IR, <sup>1</sup>H NMR and <sup>13</sup>C NMR spectral studies were performed to elucidate the structure of benzenesulfonohydrazides. In vitro urease enzyme inhibition assay revealed the compound INS-5 was found to be the most potent ( $IC_{50} = 1.11 \pm 0.29 \mu M$ ) among the tested compounds. The compound INS-2 was competitive inhibitor with  $K_i$  value  $5.60 \mu M$  while the compounds INS-1 and INS-5 were mixed type of inhibitors with  $K_i$  values 4.32 and  $2.76 \mu M$  respectively. Ancillary to synthetic studies, DFT and TDDFT calculations at B3LYP/6-311G(d,p) level of theory were performed for comparative analysis of spectroscopic data, frontier molecular orbitals (FMOs), natural bond orbital (NBO) analysis and molecule electrostatic potential (MEP) surface. Overall, experimental findings were supported nicely by corresponding DFT computed results. The NBO analysis confirmed that the presence of hyperconjugative interactions are pivotal cause for stability of investigated compounds. Global reactivity descriptors were also calculated using the energies of FMOs energies. Molecular docking studies were performed to identify the plausible binding mode of the competitive inhibitor.

**Keywords.** Urease, Hydrazides, Disease, Docking studies



**JOULE HEATING EFFECT ON CONTINUOUSLY MOVING THIN NEEDLE IN MHD  
SAKIADIS FLOW WITH THERMOPHORESIS AND BROWNIAN MOMENT**

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**ABSTRACT**

In the current study, we investigated the impact of thermophoresis and Brownian moment on the boundary layer analysis of a 2D forced convection flow of magnetic-nanofluids along a persistent moving horizontal needle with frictional heating effects. Various pertinent parameters are convoluted in the present analysis, namely, the thermophoresis and Brownian moment, uneven heat source/sink, Joule heating and frictional heating effects. To check the variation in the boundary layer behavior, we presumed the two distinct nanoparticles namely, Al<sub>50</sub>Cu<sub>50</sub> (alloy with 50% Alumina and 50% Copper) and Cu with water as pedestal liquid. Numerical solutions are procured for the reduced system of governing PDEs by employing the shooting process. Computational results of the flow, energy and mass transport are interpreted with the assistance of tabular and graphical illustrations. Obtained results indicate that increase in the needle size significantly reduces the flow and thermal fields, but, improve the concentration fields of both nanofluids. In particular, velocity field of Cu-water nanofluid is highly depreciated when equated with the Al<sub>50</sub>Cu<sub>50</sub>-water nanofluid. Also, we highlighted that the thermophoresis and Brownian moment parameters are capable of enhancing the thermal conductivity to the greater extent.

**Keywords:** Nanofluid; Frictional heating; Thermophoresis; Brownian moment; Joule heating; MHD.

**EFFECTIVENESS OF USING THE GRAPHICAL CAPABILITIES OF THE MATLAB  
COMPUTER PROGRAM IN TEACHING MATHEMATICS**

**МАТЕМАТИКАНЫ ОҚЫТУДА МАТЛАВ КОМПЬЮТЕРЛІК БАҒДАРЛАМАСЫНЫҢ  
ГРАФИКАЛЫҚ МҮМКІНДІКТЕРІН ҚОЛДАНУДЫҢ ТИІМДІЛІГІ**

**ЭФФЕКТИВНОСТЬ ИСПОЛЬЗОВАНИЯ ГРАФИЧЕСКИХ ВОЗМОЖНОСТЕЙ  
КОМПЬЮТЕРНОЙ ПРОГРАММЫ MATLAB ПРИ ОБУЧЕНИИ МАТЕМАТИКЕ**

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**ABSTRACT**

Knowledge of methods and techniques of working with mathematical and practical computer programs using information and communication technologies and computer software and hardware complex facilitates the solution of mathematical problems accurate, accurate results, etc. b. questions are studied. Therefore, in order to form students ' educational interests, it is important to study subjects in conjunction.

Mathematics is the king of Science with a deep history. I believe that in the future there will be a lot of discoveries in this field of Science, and I am sure that I will also participate in making these discoveries!

**Key words:** MatLab, operation, graphics, function, technology, communication, program, algorithm.

**АҢДАТПА**

Ақпараттық - коммуникациялық технологияларды және компьютерлік бағдарламалық - техникалық кешенді технологияларды пайдаланып, математикалық және тәжірибелік компьютерлік бағдарламалармен жұмыс жасау әдіс -тәсілдерін білу математикалық есептердің шешімін дәл, нақты нәтиже алуды жеңілдетеді және т.б. сұрақтар зерттеледі.

Сондықтан да, білім алушының білімдік қызығушылықтарын қалыптастыру мақсатында пәндерді байланыстыра оқытудың маңызы ерекше.

Математика – тарихы терең ғылым патшасы. Болашақта бұл ғылым саласында жаңалықтар көп болуына сенемін және өзім де сол жаңалықтарды жасауға ат салысатыныма сенімдімін!

**Кілт сөздер:** MatLab, операция , графика, функция, технология, коммуникация, программа, алгоритм.

**АННОТАЦИЯ**

Знание методов и приемов работы с математическими и практическими компьютерными программами с использованием информационно - коммуникационных технологий и компьютерного программно - технического комплекса облегчает решение математических задач точные, точные результаты и т. д. вопросы изучаются.

Поэтому, в целях формирования образовательных интересов обучающегося, особое значение имеет преподавание предметов в связях.

Математика-король наук с глубокой историей. Уверен, что в будущем в этой науке будет много открытий и я сам буду участвовать в создании этих открытий!

**Ключевые слова:** MatLab, операция , графика, функция, технология, коммуникация, программа, алгоритм.

It is important to master this program, because information and communication technologies have a huge impact on the formation of pedagogical and psychological conditions that allow the future generation to get a comprehensive education, business and talent, creative and free development. The future of Kazakhstan is in the hands of young people. Therefore, every citizen of our country should fully master and implement innovative technologies in their daily lives. Knowledge of information and Communication Technologies is an important factor in the development of education reform. Knowledge of these systems makes it easier to get accurate, accurate results, present them graphically, visualize reports, and so on.

The university should be able to effectively use the opportunities that arise in the educational process, taking into account the following points: the future professional activity of the Graduate, his ability to use a personal computer on a wide scale, mastering an expanded software palette and hardware environment. It is noted that due to the necessity and sufficiency of the computer mathematics system is fully integrated into the educational process, in the first university, the computer mathematics system should be given a lot of attention in the first courses of students, and only then can the computer mathematics system be used to test the results. In this regard, it is characterized by the MatLab software and mathematical system for solving computational mathematics and simulation modeling problems.

The MatLab package represents a computer environment for digital computing and displaying the results obtained. It is an effective tool for digital analysis, matrix operations, and time signal analysis. It can't be said that at present, any person does not use modeling techniques to any extent in their field of activity. In particular, it is based on the management of various industries and systems, i.e. decisions made on the basis of information received there. Currently, computer modeling and analysis is a dynamically developing direction of information science based on the use of simulation models and is widely used in the economy, industry, ecology, Subsoil Use and other human-related industries.

Modeling of objects of different physical nature is one of the ways of scientific knowledge, and the Basic Laws of the process of building models are studied in different sections of theories of knowledge. The MatLab package represents a computer environment for digital computing and displaying the results obtained. It is an effective tool for digital analysis, matrix operations, and time signal analysis.

Typical applications of the MatLab package are universal numerical calculations, layout of algorithms, analysis and synthesis of Automatic Control Systems, Statistics and digital signal processing.

The concept of graphics gives a diagram of graphic objects with certain defined properties. Despite the abundance of graphical commands, their syntax is simple and easy to explain to beginners. Following the rule "from simple to complex", we first look at the graph function as a variable, and then at the three-dimensional graph, special, animated, and descriptor graphs.

In most cases, to analyze the results of the calculation, you will need to plot its graph. The capabilities of the Matlab system are huge for this purpose. Also, to draw a graph, it is enough to use one function here. In the process of constructing a graph, Matlab opens a special graph window, where it draws the abscissa and ordinate axes, sees the values of arguments and functions, and builds a graph. You can draw multiple graphs on the same window, in different colors, with different lines. You can also change the image, design it, and save it.

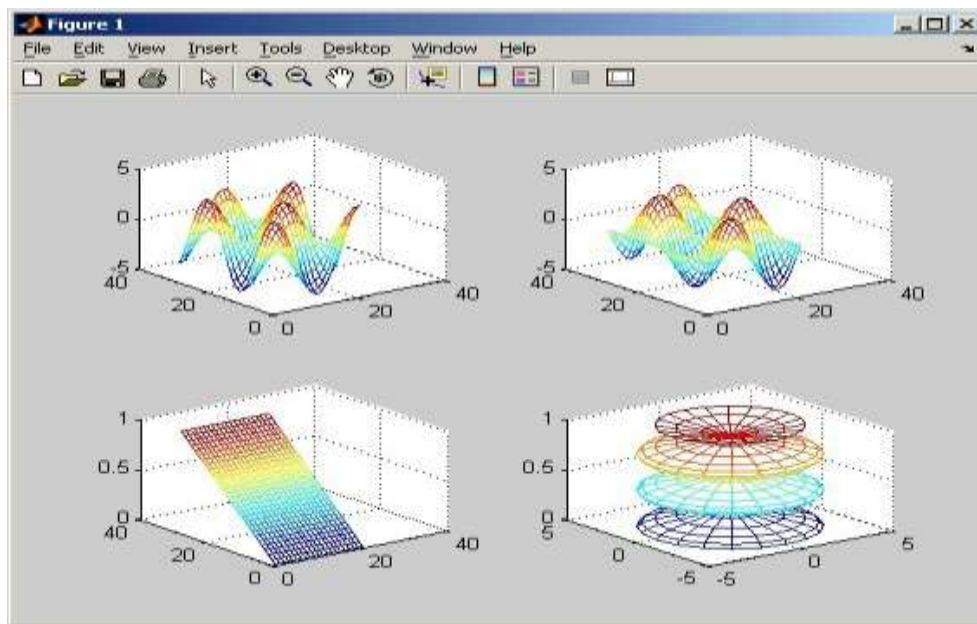
MatLab has huge capabilities for graphical representations of vectors and matrices, as well as the ability to comment and print graphs.

The Plot function has different forms, depending on the parameters entered. For example, plot(y) creates an alternating-length graph. Where y is their index. If two vectors are given as an argument, then plot(x,y) creates a dependent graph of x and y. MatLab automatically sets its own color for each graph (not performed only when the user changes it himself) and allows you to distinguish the typed ones.

Allows you to add a curve to a graph with the Hold on command.

The Subplot function allows you to output a set of graphs in a single window (picture-1).

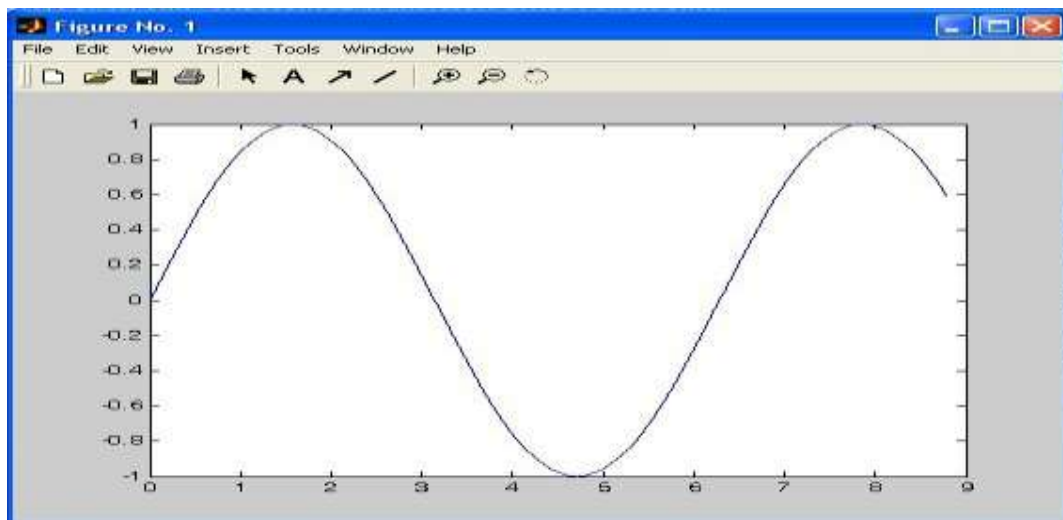
```
>> t = 0:pi/10:2*pi;
>> [X,Y,Z] = cylinder(4*cos(t));
>> subplot(2,2,1)
>> mesh(X)
>> subplot(2,2,2); mesh(Y)
>> subplot(2,2,3); mesh(Z)
>> subplot(2,2,4); mesh(X,Y,Z)
>> |
```



1-cyper.

For example:  $y=\sin(x)$  the graph of the function is given on the plane as follows:  $y=\sin(x)$ . 2- picture.

```
>> x=0:pi/100:2*pi;
>> y=sin(x);
>> plot(x,y)
```



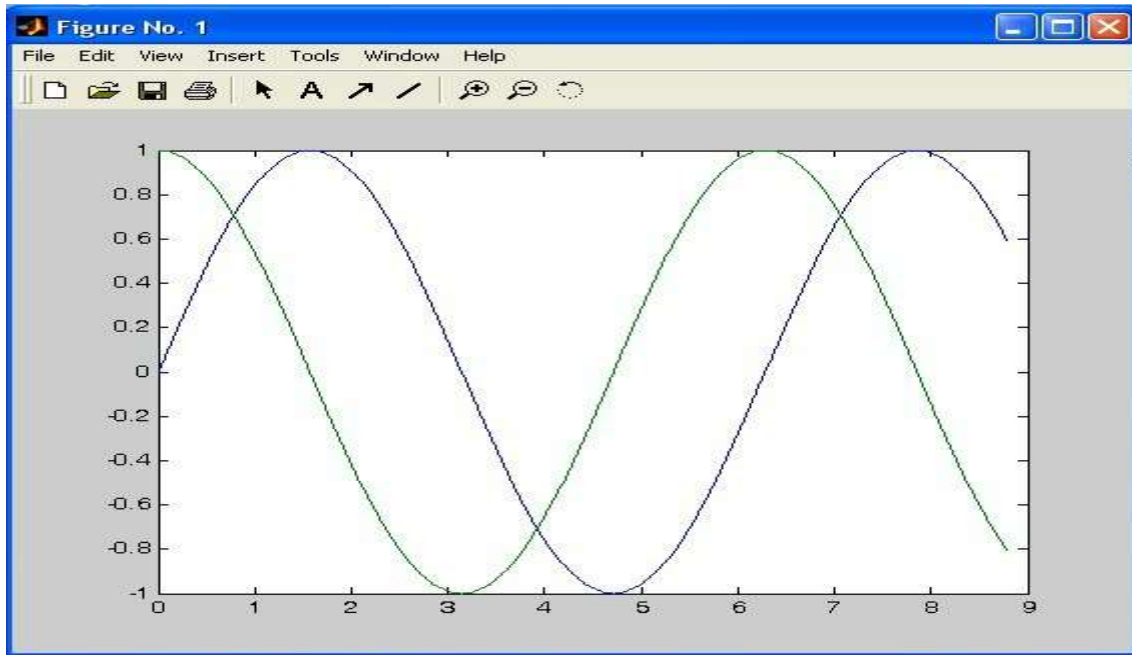
2-cyper.

Where plot x,the y function draws a graph of y according to the values of x.

If you need to draw two or more graphs in the same window, we will use the plot function as follows.

3-picture.

```
>> x=0:pi/100:2*pi;  
>> y=sin(x);  
>> z=cos(x);  
>> plot(x,y,x,z);
```



3-cyper.

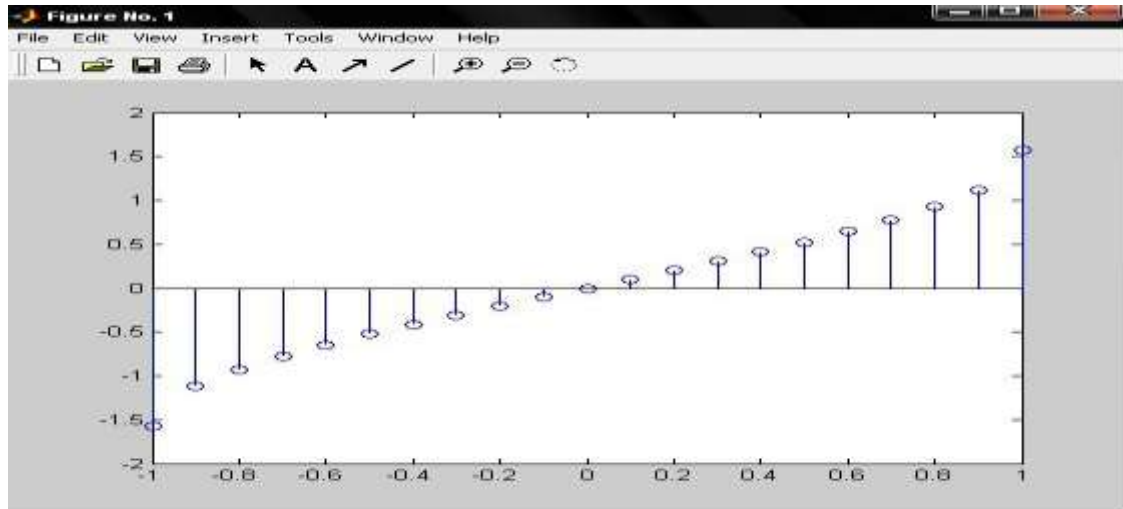
Another main problem when drawing graphs is their color and line types. Their transfer is performed after x,y in the plot command. Plot (x,y,'c\*')

Special Matlab graphics are not functional relationships between variables, but are used to visualize multi-digit aggregated data.

Another type of graphic representation of array elements is vertical lines with wheels at the end. It is drawn using the stem(x,y) function. It is usually used to illustrate the results of experiments. For example: stem graph of the arxinus function

```
>> x=-1:0.1:1;  
>> y=asin(x);  
>> stem(x,y)
```

commands are drawn by. 4- picture.



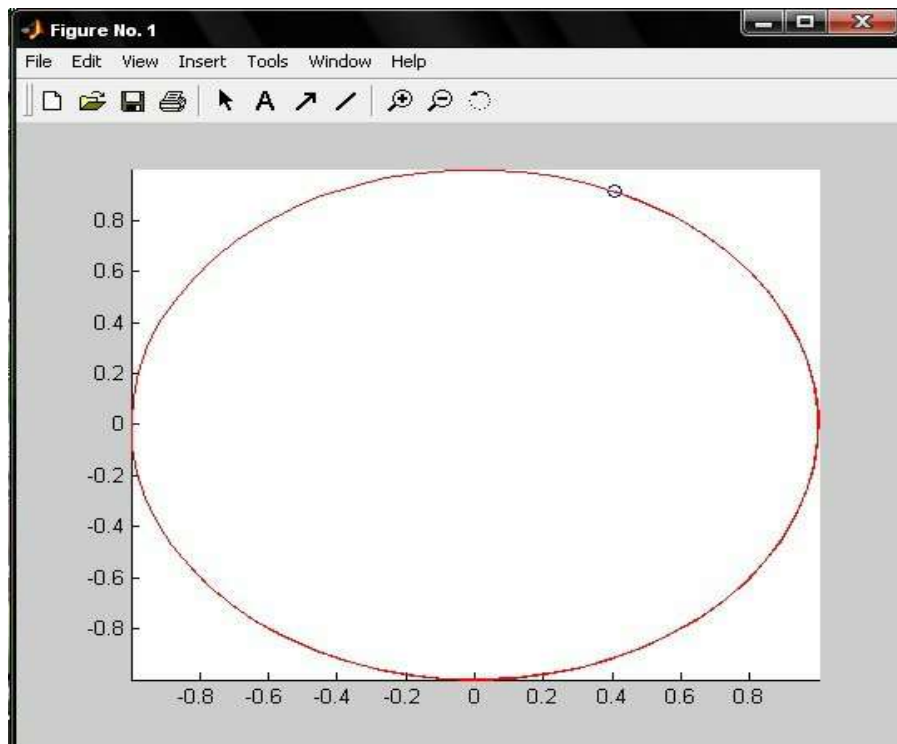
4- picture. application of the stem function.

And the movement of a body along a certain trajectory is performed using the comet (Comet) function, a dynamic visualization tool in MatLab. For example, the movement in a circle when  $t$  changes from 0 to 20 can be shown as follows: `>> t=10:0.1:20;`

`>> x=cos(t);`

`>> y=sin(t);`

`>> comet(x,y)` drawn using the commands (5- picture)



5- picture. application of the comet function.

In conclusion, I would like every citizen of the country to have deep knowledge, intelligence, fluency in modern technologies, and everyone can contribute to the development of the country. To do this, the teachers who teach them must be creative, inquisitive, and most importantly hardworking, who are well versed in their subject, able to instill theory and practice in students.

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**IMPACT OF POST COVID-19 AFFECTS ON WOMEN VIOLENCE IN PAKISTAN: A CASE  
STUDY OF DADU SINDH-PAKISTAN**

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**ABSTRACT**

The current research investigates the Impact of Post COVID-19 affects on Women Violence in Pakistan: A case study of Dadu Sindh-Pakistan. Data were collected from 300 Women working in different professions. Sukkur, and Larkana Districts. A structural Questionnaire were adopted for the reliability and validity of Data. It was revealed that fact the negative attitude of neighbors, relatives, and family members with patients makes patients depressed and hopeless to fight with the disease. In this direction, psychologists and sociologists advise showing good manners with patients so that they can make their minds stronger to resist disease. Assiduously, due to Covid-19, infected people and their families are victimized of misuse by neighbors and others, signaling the violation of human rights. Not only patients but also doctors, nurses, and volunteers are treated with truculent behaviors which are endangering the future of medical treatment of Covid-19 infected patients. It is a matter of sorrow that health workers, in general, are appreciated by others across the world but Pakistanis health workers are treated with negligence in certain places. It was further revealed that In situations prevailing in the country, as most of the Pakistanis has a lack of sufficient education and a sharp look-out, new prejudice can emerge here easily. In this process, numerous types of prejudice, deteriorating social stability, have emerged in Pakistan about Covid-19 and pre-existing prejudices have been energetic further. When someone uses masks to cover mouth and nose, others despise and say them that they wear Thus (mask of the cow). Somebody accuses the luck and argues that death comes from Allah but Islam advises to be aware of the causes of death.

**Key Words:** Phycological, COVID-19, Human Health, Pakistan.



**DESIGN AND CONTROL OF A 3 DOF ROBOTIC ARM USING SOLIDWORKS AND ARDUINO-UNO**

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**ABSTRACT**

The present work deals with the problem of planning the optimal trajectories for a manipulator robot with 3 degrees of freedom (3 DOF) in the execution of an imposed task (continuous welding) by specifying the movement of the manipulator. The 3 degrees manipulator arm named SA3 will be realized, and it will be controlled by a microcontroller Arduino Uno, by means of a set of Potentiometers. The goal of this study is to find an optimal trajectory with a time to complete the task and / or a minimum motor torque while respecting the kinematic and dynamic constraints imposed on the robot, The various direct and inverse models have been studied to extract the robot equations. The trajectories were modeled using the Cubic Spline functions, the minimization of the objective function was performed using the optimization technique of Quadratic Sequential Programming "SQP", Using Matlab and SolidWorks software for numerical results illustrate the feasibility of the proposed methodologies.

**Keywords:** Robot manipulator, simulation, optimal trajectory, Arduino Uno.

**ASSESSMENT OF ACUTE GASTROINTESTINAL BLEEDING BY DIAGNOSTIC  
INTEGRAL SCALES IN PATIENTS WITH ISCHEMIC HEART DISEASE**

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## **ABSTRACT**

The problem of gastrointestinal bleeding in patients with coronary heart disease and the principles of treatment remain an urgent task of clinical medicine. In addition to the intensive care unit, we considered it necessary to use various integrated scales for the correct assessment of treatment tactics in patients with gastrointestinal bleeding in chronic coronary heart disease. Selection of prognostic Forrest (F), Rockall, and Glasgow- Blatchford risk scales have a great importance in the diagnostic evaluation of gastrointestinal bleeding and for selection of correct treatment principles, although endoscopic examination is considered as main classic method for diagnosing bleeding from the upper gastrointestinal tract. In 18 patients were found F-1b: endoscopic hemostasis was applied to 10 of them; in 8 patients, a ligature was placed on the bleeding varicose veins. Taking into account the presence of F-2c and concomitant diseases in 88 patients, all of them were cured by conservative treatment. 44 patients underwent for surgery. Assessing the condition of the patients, determined that 33.33% of them in high-risk and 45.33% of them in higher-risk according to the Rockall scale. According to the Glasgow-Blatchford scale, 29.33% of all patients were instructed for surgery.

**Key words:** gastrointestinal bleeding, ischemic heart disease, risk factors, integral scales, Forrest, Rockall, Blatchford.

**PREVALENCE AND ASSOCIATED RISK FACTORS OF STRONGYLOIDIASIS AMONG ORPHANAGES AND SOME *ALMAJIRI* SCHOOLS IN SOKOTO METROPOLIS, SOKOTO STATE, NORTH-WESTERN NIGERIA**

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**ABSTRACT**

Strongyloidiasis is a serious public health problem in under-developed and developing countries like Nigeria. Therefore, comprehensive local epidemiological data are very vital for successful control and prevention of this infection particularly among orphanage homes and *Almajiri* schools. This study was carried out to determine the prevalence and associated risk factors of strongyloidiasis among orphanages and some *Almajiri* schools in Sokoto Metropolis, Sokoto State, North-Western Nigeria. A descriptive cross-sectional survey was conducted among a total of 400 orphans and *Almajiris* in the study area. Stool samples were collected and examined using both direct wet-mount and formalin-ether concentration techniques by following standard operating procedure. Data were analyzed using the SPSS Version 26.0 and Chi-Square ( $X^2$ ) test, and  $P < 0.05$  was considered to be statistically significant. The prevalence of strongyloidiasis was calculated and expressed in percentages. The overall prevalence of strongyloidiasis was found to be 08 (2.00%). Based on institutions, the infection rate was greatly higher in the *Almajiri* schools 07 (1.75%) than in the orphanages 01 (0.25%). In relation to gender, the infection rate was higher in males 05 (1.25%) than in females 03 (0.75%). Also, based on age-group, the subjects aged 8 – 10 years were more infected 05 (1.25%) than the rest 03 (0.75%). However, there was no statistically significant difference ( $P > 0.05$ ) between the prevalence of strongyloidiasis among orphanages and *Almajiri* schools. Type of food normally eaten, fruit/vegetable washing before eating, going to fishing/swimming, and coming in contact with refuse/sewage were significant factors ( $P < 0.05$ ) for strongyloidiasis in this study. The study revealed the prevalence of *Strongyloides stercoralis* infection among the subjects in the study area. Therefore, provision of safe food and drinking water, regular deworming exercise, government interventions, health education and discouragement of open defecation are recommended.

**Key Words:** Prevalence; Epidemiology; Risk Factors; *S. stercoralis*; Orphanage Homes; *Almajiri* Schools; Sokoto Metropolis; North-Western Nigeria.

**GÜVENLİK YÖNETİM SİSTEMİNİN ALT VE ÜST SEVİYELİ KURULUŞLARDA SEVESO  
III DİREKTİFİNE GÖRE UYGULANMASI VE DENETİM ÖRNEKLERİ**  
**IMPLEMENTATION OF SAFETY MANAGEMENT SYSTEM IN UPPER AND LOWER  
TIER ESTABLISHMENTS ACCORDING TO SEVESO III DIRECTIVE AND SPECIAL  
AUDIT CASES**

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## ÖZET

Tehlikeli kimyasalları içeren büyük endüstriyel kazalar, insanlar ve çevre için önemli bir tehdit oluşturmakta, büyük ekonomik kayıplara neden olmaktadır. Avrupa'da, 1976'da gerçekleşen ve Seveso ismiyle bilinen endüstriyel kaza, bu tür kazaların önlenmesi ve etkilerini azaltmaya ilişkin mevzuatın oluşmasına öncü olmuştur. Mevzuatın son hali olan Seveso III Direktifi, AB uyum sürecindeki Türkiye mevzuatına 2 Mart 2019 tarihinde 30702 sayılı Resmi Gazete'de yayınlanan "Büyük Endüstriyel Kazaların Önlenmesi ve Etkilerinin Azaltılması Hakkında Yönetmelik" ismi ile girerek alt ve üst seviyeli kuruluşlara birçok yükümlülük getirmiştir. Güvenlik Yönetim Sistemi kurmak bunlardan biridir.

Bu çalışmada, 2020 yılından sonra Aile, Çalışma ve Sosyal Hizmetler Bakanlığı (şu anda Çalışma ve Sosyal Güvenlik Bakanlığı) tarafından denetlenmiş kuruluşlara ait denetimler incelenmiştir. Bir firmaya ait iki alt seviyeli kuruluşun farklı zamanlarda ve farklı Bakanlık müfettişlerince gerçekleştirdiği denetim süreçleri ve sonuçları paylaşılmıştır. Denetim başında hangi uygunsuzluklara sahip oldukları ve sonradan bu uygunsuzlukları nasıl gidererek sıfır uygunsuzlukla denetimleri atlattıkları aktarılmıştır. Bu çalışmada denetim sonuçları benzer olsa da denetim süreçlerinin ne kadar farklılaşabileceği gösterilmiştir.

Gerçek denetim bulgularının paylaşımı ile endüstriyel kazaya yol açabilecek işletmelerde yapılan iyi uygulamaların paylaşımının artırılmasına hedeflenmektedir. İşletmelerde büyük bir kaza olmadan önce eksikliklerin şeffaf bir şekilde ortaya çıkarılması ve düzeltilmesi öngörülmektedir.

**Anahtar Kelimeler:** Seveso, Büyük Endüstriyel Kaza, Güvenlik Yönetim Sistemi, Aile, Çalışma ve Sosyal Hizmetler Bakanlığı

## ABSTRACT

Major industrial accidents involving hazardous chemicals pose a significant threat to humans and the environment and cause great economic losses. In Europe, the industrial accident that occurred in the Seveso in 1976 led to the creation of legislation on the prevention and control of such accidents. The latest version of the legislation, the Seveso III Directive has brought many obligations to lower and upper tier establishments. Establishing a Safety Management System is one of them.

In this study, the audits of the establishments audited by the Ministry of Family, Labor and Social Services Services (currently the Ministry of Labor and Social Security) were examined. The audit

processes and results of two lower-tier establishments belonging to a company at different times and by different Ministry inspectors were shared. It is explained which nonconformities they had at the beginning of the audit and how they eliminated these nonconformities afterwards and survived the audits with zero nonconformities. In this study, it has been shown how the audit processes can differ even though the audit results are similar.

It is foreseen that the sharing of real audit findings will increase the sharing of good practices in enterprises that may cause industrial accidents and contribute to the transparent revealing of deficiencies before they cause a major accident.

**Keywords:** Seveso, Major Industrial Accident, Safety Management System, Ministry of Family, Labor and Social Services

**SYNTHESIS, STRUCTURAL AND MOLECULAR CHARACTERIZATION OF 4,4-Diphenyl-1-propyl-2-propylsulfanyl-4,5-dihydro-1H-imidazol-5-one**

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**ABSTRACT**

Hydantoin derivatives are known for their physiological activity as anticonvulsants (Weichet, 1974) and are also widely used in many other pharmacological applications such as antiarrhythmic (Havera et al., 1976), antidiabetic (Rizzi et al., 1989), fungicidal (Thenmozhiyal et al., 2004), anti-carcinogen (Lamothe et al., 2002), antiviral (el-Barbary et al., 1994) and anti-HIV (Khodair et al., 1997) agents.

The thiohydantoin scaffold is of substantial importance and it is commonly used in drug discovery. Herein, a novel thiohydantoin-based compound, namely **4,4-Diphenyl-1-propyl-2-propylsulfanyl-4,5-dihydro-1H-imidazol-5-one** was synthesized and its crystal structure was determined by classical spectroscopic methods, <sup>1</sup>H/<sup>13</sup>C NMR, infrared spectroscopy, mass spectrometry and single-crystal X-ray diffraction (XRD) studies.

**Keywords:** Synthesis, Thiohydantoin, <sup>1</sup>H/<sup>13</sup>C NMR, Mass, IR, XRD

## OPTIMIZING THE SELECTIVITY AND CURRENT EFFICIENCY THROUGH COATED ION-EXCHANGE MEMBRANES

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### ABSTRACT

Layer-by-layer (LBL) deposition of polyelectrolyte multilayers (PEMs) on membranes greatly enhances ion-transport selectivities in dialysis and nanofiltration. This research explores monovalent/divalent ion separations in dialysis through PEM-coated membranes and examines the effect of ionic strength and pH on the ion fluxes, selectivities and limiting currents. Coated anion-exchange membranes (AEMs) show  $\text{Cl}^-/\text{SO}_4^{2-}$  selectivities as high as 140, and a moderate increase in pH gives a five-fold increase in the limiting current through modified cation-exchange membranes (CEMs). LBL polyelectrolyte coatings on membranes are attractive for their high selectivities between monovalent and divalent ions. However, deposition of PSS/PAH films on ion-exchange membranes leads to low ion fluxes that restrict productivity or current efficiency. Remarkably, increasing the solution pH from 6.5 to 8.3 enhances cation fluxes and limiting currents through (PAH/PSS)<sub>5</sub>PAH-coated CEMs while still achieving order of magnitude selectivity increases compared to bare membranes. In Donnan dialysis through (PAH/PSS)<sub>5</sub>PAH-coated Nafion, at pH 8.3 the  $\text{K}^+/\text{Mg}^{2+}$  selectivity is 100, and the  $\text{K}^+$  flux is 22 times that at pH 6.5. Moreover, at the higher pH the electro dialysis limiting current through these membranes increases ~5-fold. This enables electro dialysis separation of  $\text{K}^+$  and  $\text{Mg}^{2+}$  with a current efficiency around 0.75, a selectivity of 18, and 50%  $\text{K}^+$  recovery from the source phase. Transmembrane potential measurements and increases in  $\text{Cl}^-/\text{SO}_4^{2-}$  selectivities (from 9.5 at pH 6.5 to ~70 at pH 8.3) for porous alumina membranes coated with (PSS/PAH)<sub>5</sub>PSS films suggest that the coating becomes cation-permselective at higher pH. Increased cation transference numbers in polyelectrolyte coatings likely lead to the enhanced limiting currents for coated Nafion at higher pH. Finally, (PAH/PSS)<sub>5</sub>PAH-coated Nafion shows a  $\text{Li}^+/\text{Mg}^{2+}$  Donnan dialysis selectivity >1000 at neutral pH and a selectivity of 10 at pH 8.3. However, the  $\text{Li}^+$  flux is 6 times greater at pH 8.3, which might make operation at the higher pH desirable.

**Keywords:** Layer-by-layer, Selectivity, Electro dialysis, Anion-exchange membranes, Current efficiency



## SALT INTAKE BY CITIZENS OF KOSOVO CHALLENGE FOR PUBLIC HEALTH

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### ABSTRACT

**Introduction:** World Health Organization (WHO) recommends NaCl intake up to 5 g/day. Reducing salt intake is a public health priority and challenge. The aim of the research is to determine the average amount of salt intake in a sample of the adult population of Kosovo

**Methodology:** This transversal cross-sectional study and was performed at the country level in Kosovo. A total of 219 people aged 20-59 of both gender were included, at the country level. Participant's involvement in this research was voluntary. The amount of salt intake was estimated through the calculation of Na in the 24-hour urine..

**Results:** The research highlights that the citizens of Kosovo consume high amounts of salt, on average 23.8 g/d, approximately five times more than the value recommended by the WHO. Analyzed by gender, it is observed that men consume significantly more salt (29.46 g/d) than women (18.94 g/d) and this difference is significant  $p < 0.001$ .

**Conclusion:** The findings of this research show high values of daily salt consumption and the same will serve as a good basis in the compilation of the national strategy for reducing salt consumption at the country level.

**Keywords:** salt, intake, national strategy

## DENTAL CARIES AND FREQUENCY OF DENTAL VISITS

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### ABSTRACT

**Aim:** The purpose of this paper is to assess the oral health of children of the Roma, Ashkali and Egyptian (RAE) communities in the territory of Kosovo according to dental visits frequency.

**MATERIAL AND METHODS:** 93 males and 108 females age 6-15 from the RAE community were included in this study. The DMFT and dmft indices were evaluated for permanent and deciduous teeth according to the World Health Organization guidelines. Moreover, gingival index was evaluated using Low Silness index.

**RESULTS-** For  $H=12.77$  and  $p < 0.05$  ( $p = 0.002$ ) an important and significant difference was found between the gingival index at primary dentitions and frequency of dental visits.

Also for  $H = 8.54$  and  $p < 0.05$  ( $p = 0.01$ ) an important and significant difference was found between the dmft index and the frequency of dental visits.

**CONCLUSION:** Socio-economic conditions contribute a lot to the poor oral health of these children

**Keywords:** dental caries, socio-economic conditions, dental visits

**EFFECT OF ANAEROBIC TRAINING ON PARAOXANASE 1 (PON1) ACTIVITY AND  
ROLE OF PON1-L55M POLYMORPHISM**

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**ABSTRACT**

**Introduction:** Paraoxonase (PON) enzyme family (paraoxonase 1, 2 and 3) has antiatherosclerotic properties. The decreased PON1EA activity, PON1 levels and PON1-L55M polymorphism (PON1P) are risk factors for atherosclerosis (AS). It is known that the effects of aerobic exercises on PON1 level and PON1EA are modified by PON1P, however the effects of anaerobic training and the role of PON1P are unclear. In present study, the effects of anaerobic training on serum PON1 levels, PON1EA and HDL and its subgroups's paraoxonase activities (HDLPON1EA, HDL2PON1EA, HDL3PON1EA) as well as the role of PON1P were investigated.

**Methods:** The trained male athletes group (handball, basketball, volleyball) (AG: n=36, age=20.56±2.42 years) and the control group (CG: n=39, age=22.26±3.44 years) participated in this study. The PON1 and HDL's PON1 enzyme activities (by a kinetic methods), the protein levels of PON1 enzyme and oxLDL levels (by ELISA method) and the PON1P (from genomic DNA samples) were determined.

**Results:** Serum PON1EA, HDLPON1EA and HDL3PON1EA enzyme activities of the athletic homozygous LL and M carrier (Mc) groups were not significantly different from those of the sedentary, however the indicated enzyme activities of the athletic LL homozygous group were significantly higher than those of the Mc group (p< 0.05). When the control genotype groups were compared, the control

LL (CLL) genotype group had serum PON1EA (38.7%), HDLPON1EA (37.2%), HDL2PON1EA (41.9%) and HDL3PON1EA (33.1%) values of the control Mc (CMc) genotype.

**Conclusions:** These findings indicate that the genetically higher PON1EA activity of the LL genotype group may have an important role in the beneficial effects of anaerobic exercise training on serum PON1EA as well as HDL and its subgroups PON1 enzyme activities in the LL homozygous group. However the Mc genotype group was genetically negatively effected from anaerobic training, which is risk for AS.

**Keywords:** Paraoxonase 1, Paraoxonase PON1-L55M polymorphism, Anaerobic training, Atherosclerosis.

**REDUCE WASTE BY USING VALUE STREAM MAPPING: A CASE STUDY IN A  
DEFENCE COMPANY**

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**ABSTRACT**

Toyota production system, or as it is known, the main purpose of lean production is the fight against waste. In order to eliminate waste and produce the most qualified products at the lowest cost, we must first define all processes from input to output, see the big picture and analyze the situation. As a result, the value stream should be clarified and waste should be eliminated. The purpose of this study is to first determine the wastes in the work done by the current situation mapping method, then to minimize the waste found and to increase the productivity in the production line. Second, it is aimed to investigate the strategies used to optimize and control stock levels in production processes, to ensure a continuous supply of materials and stocks to avoid excess and insufficient stocks. In this context, the basic principles of Kaizen philosophy are used to increase productivity. Data collection was carried out in one of the largest defense companies located in Turkey. With the improvements made according to lean manufacturing, it is expected to reduce waste with future state mapping. In the developed future value flow map, transactions contrary to lean production were avoided. The results showed that the idle time was reduced by a 31% improvement rate and with the help of line balancing the line efficiency was enhanced by 63.6% in the whole operation set. The research also provides managers with the information necessary to successfully deal with efficiency problems. It guides the reduction of dead stock and the inventory review of the organization in achieving process efficiency, high production rate, reduced total processing time, minimum or zero idle time, and a potential increase in profits and decreases in costs.

**Keywords:** Kaizen, Lean Manufacturing, Value Stream Mapping, Efficiency, Toyota Production

**ANTIOXIDANT, ENZYME INHIBITION AND TOXICOLOGY STUDIES OF METHANOL  
EXTRACTS OF SELECTED MEDICINAL PLANTS**

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**ABSTRACT**

The purpose of this work was to study the biological activities of methanolic extracts of *Tagetes erecta*, *Calendula officinalis* and *Murraya koenigii* on alpha-amylase at varying concentrations. Antioxidants obtained from selected medicinal plant extracts should be able to produce the desired redox reaction, be physiologically inert, non-toxic, effective in low concentrations, and should provide prolonged stability to the formulation. The comet assay's detection of DNA damage highly depends on the cells in the selected therapeutic plant components. Environmental pollution is a major factor that has an impact on human lives as it damages cell DNA. The % radical scavenging activity was performed by using DPPH and FRAP antioxidant assays. The % inhibition of methanolic extracts were performed by using  $\alpha$ -amylase and urease inhibition assays. The toxicology studies were performed by using comet assay to check the selected plants extract's potential to damage DNA. The % inhibition of methanolic extracts of alpha amylase was noted in the range of 11.49 to 50.56 % and IC<sub>50</sub> in the range of 04.09±0.05 to 07.39±0.23  $\mu$ g/ mL respectively at the mentioned concentrations. The % urease inhibition range of leaf extracts at 300 to 400 rpm of *Tagetes erecta* were in range of 52.32 to 2.11 %. Methanolic extracts of *Tagetes erecta* showed the total phenolic contents in the range of 0.03±0.24 to 0.42±0.63 mg GA/ 100g for leaf extracts and 0.006±0.39 to 0.09±0.28 mg GA/100g for stem extracts. 0.02±0.32 to 0.17±0.38 mg GA/ 100g TPC of curry leaves and 0.02±0.32 to 0.17±0.38 mg GA/ 100g, 0.001±0.39 to 0.18±0.39 mg GA/100g for leaf and stem extracts of *Calendula officinalis*. According to researchers, the total phenolic contents in a plant largely contribute to antioxidant activity. The % radical scavenging activity of leaf extracts of *Tagetes erecta* was noted in the range of 2.13 to 76.13 % and 3.73 to 46.31 % by using DPPH and FRAP antioxidant assays. The current experiment showed that NDEA increased DNA damage, as indicated by the lengthening of the comet tail. Ingestion of *T. erecta* leaf extract significantly reduced protein and lipid oxidation and lessened DNA damage, which is interpretable as a decrease in oxidative stress brought on by NDEA. The results of the work therefore, clearly indicate the potential of these extracts to manage hyperglycemia and oxidative stress. The evaluation of enzyme inhibition and antioxidant potentials of plant extracts has been done by using 96-well microplate reader technique. Data obtained has been statistically analyzed using appropriate statistical tools.

**Keywords:** *Tagetes erecta*, *Calendula officinalis*, *Murraya koenigii*, antioxidant, enzyme inhibition, comet assay, evaluation and statistical analysis.

**MATHEMATICAL MODELLING OF THE EFFECTIVENESS OF AN OSCILLATING  
WATER COLUMN WAVE ENERGY CONVERTER (OWC)**

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**ABSTRACT**

The oscillating water column is considered one of the most efficient energy converters for exploiting the ocean's immense potential. Its operating principle is to produce an air current in a chamber benefiting the alternation by the motion of the waves; this air current is then forced to flow through the well's turbine (which functions as a PTO) to generate electrical energy.

It is very important to construct a mathematical combination between the geometric parameters of OWC and the environmental conditions of the waves in order to improve this conversion of pneumatic energy into electrical energy.

In this sense, our study produced a mathematical model to assess the effectiveness of OWC under specified climatic circumstances of significant heights and wave period.

The result shows that the annual-averaged efficiency may be significantly increased with the right combination of chamber length, submergence depth, and turbine parameters.

**Keywords:** Oscillating water column device, Wave power Efficiency, geometric parameters

**YOĞUN BAKIM HEMŞİRELERİNİN BASINÇ ÜLSERLERİ KONUSUNDA BİLGİ  
DÜZEYLERİNİN DEĞERLENDİRİLMESİ**  
**EVALUATION OF THE KNOWLEDGE LEVELS OF INTENSIVE CARE NURSES ABOUT  
PRESSURE ULCERS**

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## **ÖZET**

**Giriş:** ‘Bası yarası’, ‘basınç ülseri ve ‘dekübit ülseri’ Avrupa Basınç Ülseri Danışma Paneli (EPUAP) ve Ulusal Basınç Ülseri Danışma Paneli (NPUAP) tarafından, "tek başına, basınç ya da yırtılma ile basıncın bir arada sebep olduğu, genellikle kemik çıkıntılar üzerinde ortaya çıkan, lokalize deri ve / veya deri altı doku hasarı" olarak tanımlanmaktadır (1). Basınç ülseleri (BÜ) hastaların fiziksel ve ruhsal sağlığını etkilemekte, artmış hastanede kalış ve morbiditeye yol açabilmektedir (2).

**Amaç:** Yoğun bakım ünitesinde (YBÜ) çalışan hemşirelerin BÜ konusunda eğitim ve bilgi düzeyini belirlemektir.

**Materyal-Metod:** Hastanemiz etik kurulunun izni (2011-KAEK-25 2021/12-08) ile 24 sorudan oluşan anketin gönüllü yoğun bakım hemşirelerine google form üstünden yapılması planlandı.

**Bulgular:** Çalışmaya 175 hemşire katıldı. Katılanların %65’i kadın, %65.7 si 29 yaş altındadır. Katılanların %64.6’sı lisans mezunu, %53.7 si 5 yıldan daha kısa süredir hemşiredir. YBÜ çalışma süreleri %38.3 ünün 3 yılın altında, %54.3’ü EAH’de, %74.9 u genel YBÜ, %79.4 ü 3. Basamak YBÜ’de çalışmaktadır. %62.9’u BÜ konusunda eğitim almıştır. YBÜ’lerin %57.1’inde yara bakımı için ekip mevcut. Hemşirelerin %4’ü çalıştığı hastanede vizitlerde BÜ konusunda hiç bilgi paylaşılmadığını belirtti. Hemşirelerin %45.7’sinin nöbet sayısı ayda 10 ve üstündedir. Basınç ülseri gelişimi için en sık risk faktörleri ileri yaş, immobilizasyon, malnütrisyon, hipotansiyondur. En sık tutulum yerleri ise sakrum, koksiks, topuk ve sırttır. Herhangi bir risk ölçeği kullanan %83.4 iken %79.6’sı ise Braden Ölçeğini kullanmaktadır. Hemsirelerin %65.1’i sıklıkla BÜ ile karşılaşmaktadır. Bilgisinin yeterli bulan %41.1 iken eğitim almak isteyen %63.4’dür.

**Tartışma:** Yapılan bir çalışmada hemşirelerin %33.1’inin “sıklıkla” BÜ ile karşılaştıkları saptandı (3). Çalışmamızda bu oran %65.1’dir. Araştırmaların %66.4’ünde BÜ risk ölçeği kullanıldığı ve %43.4’ü Braden ölçeği olduğunu belirtmiştir (4). Çalışmamızda bu oranlar %83.4 ve %79.6 bulunmuştur.

**Sonuç:** Basınç ülseri gelişimini önleme ve tedavi konusunda yoğun bakım hemşirelerinde eğitim ve bilgilendirme isteği olduğunu düşünmekteyiz.

**Anahtar Kelimeler:** Basınç ülseri; Braden risk değerlendirme ölçeği; İmmobilizasyon.

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## ABSTRACT

**Introduction:** 'Pressure ulcers' (PU) are defined by the European Pressure Ulcer Advisory Panel (EPUAP) and the National Pressure Ulcer Advisory Panel (NPUAP) as "bony prominences caused by pressure, either by pressure or shearing." It is defined "localized skin and/or subcutaneous tissue damage on the skin" (1) and may affect physical and mental health of patients, lead increased hospital stay and morbidity (2). The aim is to determine the education level and knowledge of nurses in the intensive care unit (ICU).

**Material- Method:** With the permission of our hospital's ethics committee (2011-KAEK-25 2021/12-08), 24 questions was administered to volunteer intensive care nurses via google form.

**Results:** 175 nurses participated, 65% women, 65.7% under 29 years. Undergraduates are 64.6%, 53.7% are working less than 5 years. ICU working times are less than 3 years in 38.3%. 54.3% are working in ICU, 74.9% in general ICU, 79.4% in 3rd level ICU. 62.9% has PU education. A team for PU is in 57.1%. No information was shared about PU during the visits stated %4 of them. The number of shifts in 45.7% of them is 10 or more per month. The most common risk factors for PU are advanced age, immobilization, malnutrition and hypotension. The most common sites are sacrum, coccyx, heel and back. 83.4% use any risk scale, 79.6% use the Braden Scale. Nurses frequently encounter PU are 65.1%. 41.1% find their knowledge sufficient, 63.4% needs education.

**Discussion:** In a study, 33.1% of nurses "frequently" encountered PU (3). This is 65.1% in our study. The risk scale for PU in studies at a rate of 66.4%, of which 43.4% is the Braden risk scale (4). We found 83.4% and 79.6%, respectively.

**Conclusion:** We think that ICU nurses need education about the prevention and treatment of PU.

**Key words:** Pressure Ulcers; Braden risk scale; Immobilization.

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## POLİMORFİZMİN İLAÇ GELİŞTİRME SÜRECİNDEKİ ÖNEMİ THE IMPORTANCE OF POLYMORPHISM IN THE DRUG DEVELOPMENT PROCESS

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### ÖZET

İlaç geliştirme çalışmalarının ana amacı güvenli ve etkili ilaç formülasyonlarının sentezlenebilmesi için gerekli olan bilgilerin toplanmasıdır. İlaç geliştirme çalışmaları boyunca üretilen formülasyonun oda sıcaklığında stabil olarak kalması oldukça önemlidir. Zorlu stabilite testlerine maruz bırakılan ilaç etken maddesinde herhangi bir polimorfik değişimin olup olmadığı mutlaka belirlenmelidir. Polimorfizm, “poly” çok ve “morphe” şekil anlamına gelen iki kelimenin bir araya gelmesiyle oluşmuş Yunanca bir kelimedir. Hem organik hem de inorganik farmasötik bileşikler, benzer kimyasal içeriğe sahip iki veya daha fazla katı formda kristalleşebilir, buna polimorfizm denir. Aynı kimyasal yapı ve farklı iç kristal ağlarına sahip polimorflar katı ilaç etken maddelerinde oldukça sık görülmektedir. Aktif farmasötik bileşenlerin % 50'den fazlası birden fazla polimorfik forma sahiptir. Ancak sıvı ve gaz halinde bu farklılıklar oluşmamaktadır. Polimorfizm, ilaç endüstrisinde hala büyük bir problem olarak karşımıza çıkmaktadır. Bunun en temel nedeni, polimorfizmin doğasının tahmin edilmesinin oldukça zor olmasıdır. Polimorflar, farklı moleküller arası veya atomlar arası mesafelere ve birim hücrelere sahiptir, bu da yoğunluk, çözünürlük, çözünme hızı ve biyoyararlanım gibi farklı fiziksel ve kimyasal özellikler ile sonuçlanmaktadır. Aktif farmasötik bileşenler ve yardımcı maddeler (eksipiyantlar) dahil olmak üzere farmasötik formülasyonlarda kullanılan birçok madde polimorfizm sergileyebildiğinden, her bir madde için farklı polimorfik formları karakterize etmek ve kontrol etmek önemlidir. Çünkü polimorfizm, ilacın davranışı üzerinde önemli farklılıklara neden olabilmektedir. İlaç endüstrisinde, katı bir ilaç etken maddesinin tahmin edilemeyen polimorfik değişiklikleri kimyasal, fiziksel ve terapötik stabiliteyi, çözünürlüğü, çözünme hızını, morfolojiyi, higroskopikliği ve nihayetinde biyoyararlanımı etkileyebileceğinden, önformülasyon aşamasında polimorfizmin belirlenmesi kritik öneme sahiptir. Bu derlemede, ilaç geliştirme çalışmaları sırasında etken maddelerde meydana gelen çeşitli polimorfik değişimler ve bunların sebep olduğu farklılıklar incelenmektedir.

**Anahtar Kelimeler:** Polimorfizm, İlaç geliştirme, Aktif farmasötik bileşen

### ABSTRACT

The main purpose of drug development studies is to collect the information necessary for the synthesis of safe and effective drug formulations. It is very important that the formulation produced during drug development studies remains stable at room temperature. It must be determined whether there is any polymorphic change in the active drug substance that has been subjected to rigorous stability tests. Polymorphism is a Greek word formed by combining two words “poly” meaning many and “morphe” meaning shape. Both organic and inorganic pharmaceutical compounds can crystallize into two or more solid forms with similar chemical content, this is called polymorphism. Polymorphs with the same chemical structure and different internal crystal networks are quite common in solid drug active ingredients. More than 50% of active pharmaceutical ingredients have more than one polymorphic form. However, these differences do not occur in liquid and gaseous states. Polymorphism is still a big problem in the pharmaceutical industry. The main reason for this is that the nature of polymorphism is very difficult to predict. Polymorphs have different intermolecular or interatomic distances and unit cells, resulting in different physical and chemical properties such as density, solubility, dissolution rate and bioavailability. Because many substances used in pharmaceutical formulations, including active pharmaceutical ingredients and excipients, can exhibit polymorphism, it is important to characterize and control the different polymorphic forms for each substance. Because polymorphism can cause

significant differences in the behavior of the drug. In the pharmaceutical industry, identification of polymorphism at the preformulation step is critical, as unpredictable polymorphic changes of a solid API can affect chemical, physical and therapeutic stability, solubility, dissolution rate, morphology, hygroscopicity, and ultimately bioavailability. In this review, various polymorphic changes that occur in active ingredients during drug development studies and the differences they cause are examined.

**Keywords:** Polymorphism, Drug development, Active pharmaceutical ingredient

## EFFECT OF PACKAGING ON THE STABILITY OF DRUGS

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### ABSTRACT

One of the most important factors to be considered in the design and development of drug dosage forms is the stability of the active substance and the end product. Stability is one of the most important quality indicators. Stability is the ability of a drug to be stored without losing its physical, chemical and therapeutic properties during the period from the first preparation stage to the time when it will be consumed. For this purpose, the shelf life of the drug is determined by performing various stability tests on selected batches. The shelf life of a drug is considered to be the period in which 10% of the active pharmaceutical ingredient decomposes. The packaging is responsible for the effective and safe preservation of the drugs until the expiration date. There are three types of packaging for use in drugs. These are primary packaging, secondary packaging and outer packaging. These packaging types interact with the drug directly or indirectly. After a drug dosage form is produced, it is necessary to choose an ideal packaging that will protect it from temperature, humidity and light. In addition, the selected packaging material should not adversely affect the drug content in physical, chemical, microbiological and therapeutic aspects. Glass, plastic, metal and rubber packaging are mostly used as pharmaceutical packaging. Appropriate stability tests should be performed by drug manufacturers to ensure that there is no incompatibility between the drug and the package. In this study, the effects of drug packaging on drug stability are investigated.

**Keywords:** Drug packaging, stability, shelf life

## IN SILICO INVESTIGATION OF SEVERAL SERIES OF HETEROCYCLIC MOLECULES FOR DRUG DISCOVERY

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### ABSTRACT

Drug discovery and design are inextricably linked to various branches of chemistry, particularly organic chemistry. Many aspects of chemistry must be involved in order to translate knowledge of the molecular, genetic, and cellular bases of cancer into effective therapies. Thus, the goal of this research is to identify promising active compounds for coumarin as CK2 protein kinase inhibitors using a QSAR model and drug similarity analysis. CK2 is a ubiquitous Ser/Thr-specific protein kinase that is required for cell cycle viability and progression. CK2 levels are particularly high in proliferating, normal, or transformed tissues, and transgenic mice expressing its catalytic subunit are responsible for lymphomas.

The work began with the optimization of the equilibrium structures of the basic coumarin in order to select the most reliable forecasting approach compared to experimentation and at the lowest computational cost. Following our research, we conduct a multiple linear regression (MLR) analysis to generate QSAR models.

An external validation research was done because the results show that the QSAR model of CK2 inhibitory activity is robust and has extremely strong prediction capacity, as indicated by R<sup>2</sup> values of 0.951 and 0.927, respectively, following linear regression analysis. The investigation using QSAR models is successful in screening 34 candidate chemicals. Following that, the compounds under consideration were evaluated for drug-likeness and reactivity (ADME, golden triangle, lipophilicity indices).

The results reveal that when supplied orally, the majority of the substances have no bioavailability issues.

The data also aid in determining which chemicals do not have clearance issues, as well as which are the most stable and reactive among those examined.

The anticipated findings of this study may aid in the development of novel coumarins with significant CK2 inhibitor activity.

**Keywords:** coumarine, CK2, QSAR, MLR.

**IMPROVING TEACHING AND LEARNING OF SENIOR HIGH SCHOOL ORGANIC  
CHEMISTRY THROUGH COLLABORATIVE APPROACHES**

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**ABSTRACT**

This study investigated Senior High School (SHS) Chemistry students' performance and retention in Organic Chemistry using collaborative teaching and learning models. Quasi-experimental design was adopted for the study. The target population for the study was third year SHS Chemistry students. Two intact classes were each purposively selected and grouped into control and experimental groups respectively in three SHSs in Tamale Metropolis in Northern Region, Ghana. The main research instruments were self-constructed Organic Chemistry Achievement Test (OCAT) and students' attitude and perception towards organic chemistry questionnaire, (SAPQ). A pre-test and SAPQ were administered to both the control and experimental groups, in each Senior High School after which an intervention using collaborative approaches for teaching and learning organic chemistry and SAPQ were conducted on the experimental group. After three weeks of interventions, a post-test was administered to both the control and experimental groups. The students' perception and attitude towards Organic Chemistry questionnaire data was analysed using Descriptive statistics and Organic Chemistry Achievement Test (OCAT) was analysed using Chi Squared ( $X^2$ ) statistics. The data revealed a significant positive change (20%) in students' perception and attitude towards Organic Chemistry by the experimental groups. Attitudes and perceptions such as; Chemistry is difficult especially naming of hydrocarbons is confusing and Organic Chemistry makes me nervous scored significant positive change. There was also a significant 25% increase in students' confidence level towards Organic Chemistry. The results further revealed a 21.4% increase in post-test mean scores by the experimental group due to the impact of using collaborative teaching and learning models as intervention on knowledge and understanding, and knowledge and application. Collaborative teaching and learning approaches were judged effective in improving Senior High School students' conceptual understanding of Organic Chemistry. It was recommended that collaborative teaching and learning approaches among students should be encouraged in Senior High schools.

**Keywords:** Collaborative learning, Cooperative learning strategies, Jigsaw, Group discussions.

**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 acid-secrete 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.



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