HYBRID INTERNATIONAL CONFERENCES
15-16 November 2025

ICBMS-IX, ICNFEAS-IX (Türkiye)
ICCMM-V (Italy)
ICBM-IX (Hungary)

Conference Abstract Book

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Organized and Supported by:

PREFACE

We are delighted to present the **Conference Abstract Book** for the Hybrid International Conferences: **ICBMS-IX**, **ICNFEAS-IX** (Türkiye), **ICCMM-V** (Italy), and **ICBM-IX** (Hungary), scheduled for **November 15–16, 2025**.

This conference series serves as a vibrant platform for engaging discussions and knowledge exchange on recent advancements across a wide range of disciplines, including **biological, medical, biomedical, food and nutrition, environmental, and agricultural sciences**.

The event brought together participants from diverse regions of **Asia, Africa, and Europe**, representing countries including Iran, Algeria, Türkiye, Egypt, Hungary, Romania, Belgium, Germany, Bangladesh, Tunisia, Italy, Greece, Saudi Arabia, and the United Arab Emirates. It provided an excellent opportunity for researchers to showcase and discuss their latest findings within their respective scientific domains.

This **Conference Abstract Book** includes written versions of the majority of contributions presented during the conference, as well as refereed abstracts accepted for publication in this volume. All submissions underwent a **rigorous blind peer-review process** conducted by members of the **Scientific Committee** and **Editorial Board**. Acceptance for oral or poster presentation was based on criteria of originality, relevance, and clarity, ensuring the high quality of the material presented.

Please note that this volume contains **abstracts only**. Both abstracts and full-text papers will be published in the **International Journal of BioLife Sciences (IJBLS)** (ISSN: 2821-1642) and the **International Journal of BioMed Insights (IJBMI)** (ISSN: 3041-9107). These journals will be made available online for open access to the academic community.

We extend our sincere gratitude to all participants for their valuable contributions to the conference program and this Abstract Book. Our appreciation also goes to the **Conference and Session Chairs**, as well as the **Technical Support Team**, for their dedication and cooperation. We are honored to acknowledge the **scientific support** provided by **Akdeniz University (Türkiye)** and **Avicenna International College (Hungary)**.

Finally, we wish all participants a **productive and enjoyable conference experience** and extend our best wishes for success in your technical presentations.

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With the Best Regards,

Organizing Committee

November 15-16, 2025

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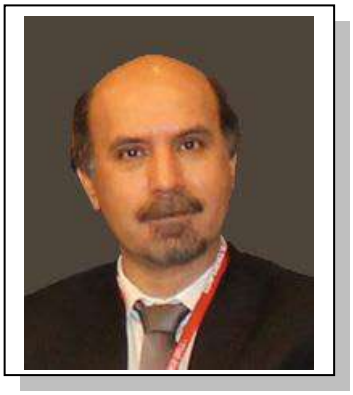
WELCOME MESSAGE

Dr. Rahim Ahmadi

GREEN President;
AIC Member, Budapest, Hungary



Dear Distinguished Colleagues, Precious Researchers,

As the head of the organizing committee, it is with great pleasure and pride that I extend a warm welcome to all the participants of the "HYBRID NTERNATIONAL CONFERENCES: ICBMS-IX, ICNFEAS-IX (Türkiye), ICCMM-V (Italy) and ICBM-IX (Hungary)" taking place on November 15-16, 2025. These hybrid international conferences are made possible through the collaboration and support of Akdeniz University, Avicenna International College (AIC), the International Association of Scientists (IAS), the Global Research, Education and Event Network (GREEN), and the Academy of International Research, Events, and Courses (AIREC).

It is a great pleasure to welcome you to these distinguished conferences, where we will explore significant and thought-provoking topics across the life sciences, medicine, biomedicine, food and nutrition, as well as environmental and agricultural sciences.

I am confident that each of you will encounter subjects closely aligned with your academic and professional interests and will gain valuable insights from the many enriching discussions that will take place throughout the event. I am particularly enthusiastic about the opportunities this gathering will provide for meaningful exchanges of ideas and experiences among esteemed professors, researchers, colleagues, and friends from renowned universities, research institutions, and international organizations.

Moreover, I sincerely hope that this conference serves as a catalyst for new ideas and collaborations, inspiring innovative research and advancing scientific understanding within your respective fields.

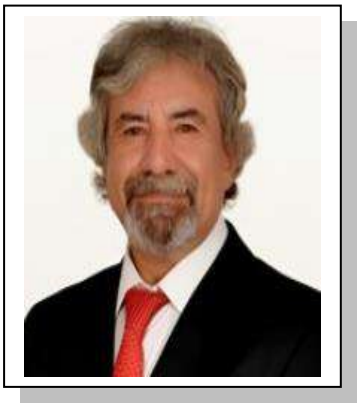
Once again, I extend my warmest welcome and best wishes to all participants for a productive, inspiring, and memorable experience.

Kind regards,
Dr. Rahim Ahmadi
Organizing Committee (Head)
November 15-16, 2025

WELCOME MESSAGE

Prof. Dr. Bülent Topcuoğlu

Plant and Animal Production Department, Technical Sciences Vocational School, Akdeniz University, Antalya, Türkiye.



Dear Distinguished Delegates, Colleagues and Guests,

The Organizing Committee warmly welcomes our distinguished delegates and guests to the Hybrid International Conferences: ICBMS-IX, ICNFEAS-IX (Türkiye), ICCMM-V (Italy), and ICBM-IX (Hungary) scheduled for November 15–16, 2025. These conferences are being organized through the joint efforts of Akdeniz University (Türkiye) under an official collaboration agreement with GREEN—an agreement I am honored to have successfully finalized. The primary aim of these events is to bring together members of the global scientific community, providing an international platform where researchers from around the world can present their cutting-edge work. The conferences have invited and gathered technical research submissions related to all major themes and tracks of the respective events.

All submitted papers and abstracts included in the proceedings have undergone a rigorous peer-review process conducted by reviewers from the Scientific Committee, external experts, and the Editorial Board, depending on the subject matter. Following this comprehensive review, the selected papers and abstracts were chosen based on their originality, significance, and clarity.

The conference program is exceptionally rich, featuring high-impact presentations that reflect the latest advancements in the respective fields. This event offers a unique opportunity for participants to explore innovative research findings within their areas of expertise while also expanding their knowledge across other disciplines.

We would like to express our sincere gratitude to the organizing staff and members of the program committees for their dedicated efforts, and to all contributors whose work has ensured the success of these conferences. We hope that all participants and readers find the proceedings both scientifically valuable and intellectually stimulating.

With our warmest regards,
Prof. Dr. Bülent Topcuoğlu
Conference Chair
November 15-16, 2025

WELCOME MESSAGE

Prof. Dr. Afrim Tabaku

Aldent University, Tirana, Albania.

Dear colleagues,

As a member of the Scientific Committee and Chief Representative of IAS, GREEN, and AIREC, as well as the Conference Chair, it is my great pleasure to warmly welcome you to the International Conferences: ICBMS-IX and ICNFEAS-IX (Türkiye), ICCMM-V (Italy) and ICBM-IX (Hungary). These conferences are dedicated to expanding the horizons of scientific knowledge by introducing fresh perspectives and insights into recent discoveries and emerging trends across the disciplines of medical, biological, food and nutrition, environmental, and agricultural sciences. The diverse topics to be explored encompass artificial intelligence (AI), life sciences, biology, biomedical and health sciences, medicine, pharmaceutical sciences, food science, and environmental and agricultural research.

By hosting these international conferences, we aim to foster meaningful scientific exchange and interdisciplinary dialogue, particularly among early-career researchers, PhD candidates, and MSc students. We believe that active engagement among participants will not only inspire innovation but also strengthen global collaborations and promote the advancement of sustainable scientific solutions to contemporary challenges.

These conferences serve as a vibrant platform for researchers, academicians, and professionals to share pioneering ideas, present their latest findings, and discuss the implications of scientific progress in shaping a healthier, more sustainable future. Through keynote lectures, oral and poster presentations, and interactive sessions, participants will have the opportunity to gain invaluable insights, network with distinguished experts, and explore new directions for collaborative research.

We deeply appreciate your participation, enthusiasm, and valuable contributions, which are vital to the continued success of these conferences. On behalf of the organizing committees, I extend my heartfelt gratitude to all delegates, speakers, reviewers, and sponsors for their dedication and support.

I wish you all an inspiring, productive, and memorable conference experience, filled with fruitful discussions, new connections, and the spirit of scientific discovery.

With best wishes,
Prof. Dr. Afrim Tabaku
Aldent University,
Tirana, Albania.

Dr. Mirela Tabaku

University of Medicine, Tirana, Albania.

Dear participants,

It is my great pleasure, as the Conference Chair, to warmly welcome you to the International Hybrid Conferences: ICBMS-IX and ICNFEAS-IX (Türkiye), ICCMM-V (Italy), and ICBM-IX (Hungary).

These hybrid conferences serve as dynamic platforms where students, scholars, and researchers from across the world come together—both in-person and virtually—to exchange ideas, present their work, and engage in meaningful dialogue without barriers of distance or access. We are truly delighted to see such a diverse group of participants, representing various disciplines, institutions, and countries. Your presence enriches these events with new perspectives and fosters an environment of collaboration and learning.

We are also honored to host distinguished keynote speakers who will share their insights on emerging trends, challenges, and innovations in their respective fields. Their contributions will undoubtedly inspire fresh ideas and guide participants toward new directions in their research endeavors.

I would like to express my sincere appreciation to all contributors—organizing committees, reviewers, presenters, and attendees—whose efforts and enthusiasm make these conferences possible. Together, we are building a vibrant network of researchers and professionals committed to advancing knowledge and promoting global scientific exchange.

I wish you all an inspiring, productive, and memorable conference experience—one filled with stimulating discussions, meaningful collaborations, and the spirit of scientific discovery. May these days be an opportunity not only to share what you have achieved but also to learn, connect, and envision the future of your research journey.

With warm regards and best wishes,
Dr. Mirela Tabaku
Conference Chair
University of Medicine
Tirana, Albania

Keynote Speech

ONLINE

KEYNOTE SPEECH

PROF. DR. BÜLENT TOPCUOĞLU
Akdeniz University
Türkiye

TITLE:

EFFECTS OF FOLIAR AND SOIL COBALT APPLICATIONS ON BIOFORTIFICATION AND PHYSIOLOGICAL PARAMETERS IN TOMATO PLANTS

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Organized by:
AKDENIZ UNIUVERSITY, GREEN, IAS, AIREC

Keynote Speech

ONLINE

KEYNOTE SPEECH

PROF. DR. GAUSAL AZAM KHAN
King Faisal University, Al Ahsa
KSA

TITLE:

ACTIVATION OF THE ERNA-TLR3 PATHWAY EXACERBATES MYOCARDIAL DAMAGE UNDER HYPOXIC

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Türkiye Time

Organized by:
AKDENIZ UNIUVERSITY, GREEN, IAS, AIREC

Keynote Speech

ONLINE

KEYNOTE SPEECH

PROF. DR. MD. AMINUR RAHMAN
Department of Fisheries and Marine Bioscience,
Faculty of Biological Science and Technology,
Jashore University of Science and Technology,
Jashore, Bangladesh

TITLE:
Transforming Waste to Wealth: The Power of Recycling and Sustainable Waste Management in Fostering Economic Growth, Protecting Human Health, and Preserving the Environment

17:05 - 17:25
Türkiye Time

Organized by:
AKDENIZ UNIUVERSITY, GREEN, IAS, AIREC

Keynote Speech

ONLINE

KEYNOTE SPEECH

DR. SH. MIRZAHOSSEINI
GREEN Chief CM; Session Chair
Avicenna International College, Hungary

TITLE:

EXPLORING STUDENTS' AWARENESS AND ATTITUDES TOWARD THE USE OF ARTIFICIAL INTELLIGENCE IN TEACHING BIOLOGY AND ITS FUTURE PROSPECTS

11:30 - 11:50 AM
Türkiye Time

Organized by:
AKDENIZ UNIUVERSITY, GREEN, IAS, AIREC

Keynote Speech

IN-PERSON

KEYNOTE SPEECH

DR. MIRELA TABAKU
University of Medical Sciences, Tirana
Albania

TITLE:

POTENTIAL ANTICANCER EFFECTS OF DICLOFENAC IN HUMAN PANCREATIC CANCER CELLS

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Türkiye Time

Organized by:
AKDENIZ UNIUVERSITY, GREEN, IAS, AIREC

Special Talk

IN-PERSON

KEYNOTE SPEECH

DR NAZILA BAHMAIE
Department of Medical Biology, Faculty of Medicine,
Ankara Yildirim Beyazit University, Ankara
Türkiye

TITLE:

CRITICAL ROLES OF MOLECULAR SIGNALING PATHWAYS IN MULTIPLE PRIMARY TUMORS; A MISSING PIECE IN THE PUZZLE OF BREAST CANCER PRECISION MEDICINE

9:30 - 9:50 AM
Türkiye Time

Organized by:
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ABSTARCTS

Neurophysiological Signatures of Sensory-Processing Sensitivity: A Review of Brain Circuitry and Implications for Sensory Disorders

Sogol Fereydouni Balangani

Department of Biology, Division of Animal and Human Physiology,
National Kapodistrian University of Athens, Athens, Greece.

Background and Aim: Sensory-Processing Sensitivity (SPS) is a personality characteristic marked by increased sensitivity to emotional and environmental stimuli. People with elevated SPS demonstrate more profound cognitive processing, heightened emotional responses, and increased awareness of subtle stimuli. Though SPS isn't categorized as a disorder, it shares sensory characteristics observed in clinical conditions like autism spectrum disorder (ASD), anxiety, and sensory processing disorder (SPD). This review seeks to integrate recent neurophysiological discoveries regarding SPS, emphasizing brain circuitry and its relevance to sensory-related disorders.
Methods: A thorough investigation was carried out utilizing the Web of Science, PubMed, ScienceDirect, and Scopus databases for articles that have been peer-reviewed and published from 2015 to the present. Research was included if it explored neurophysiological correlates of SPS through techniques like fMRI, EEG, MEG, or PET. Information regarding brain areas, neural connectivity, and sensory processing was gathered and examined.
Results: Results indicate that persons with elevated SPS demonstrate heightened activity in brain areas associated with emotional regulation, social cognition, and sensory integration, such as the insula, anterior cingulate cortex, and superior temporal sulcus. Increased functional connectivity in both the default mode and salience networks has been noted as well. These patterns differ from those observed in clinical sensory disorders, though there are some overlapping characteristics. The neurophysiological characteristics of SPS reveal a distinct, non-disordered sensitivity that could make individuals prone to both weaknesses and adaptive abilities.
Conclusion: SPS is linked to unique neural patterns that indicate heightened sensory and emotional processing. Comprehending these patterns can enhance the

differentiation between SPS and sensory-related disorders, benefiting both research and clinical applications.

Keywords: *Sensory-processing sensitivity, Brain circuitry, Neurophysiology, Sensory integration, Emotional reactivity*

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Antioxidant, Antihemolytic, Antithrombotic and Anti-inflammatory Activity of Seed Extracts from *Styphnolobium japonicum*

Karima Saffidine*, Younes Douffa, Thoraya Guemaz, Fatima Zerargui, Abderahmane Baghiani

Laboratory of Applied Biochemistry, Faculty of Nature and Life Sciences, University Setif1, Ferhat Abbas, Setif 19000, Algeria

Background and Aim: Antioxidants can prevent or treat diseases linked to oxidative stress. Research on medicinal plants known for their beneficial effects to protect human health has increased as a result of the search for more potent alternatives to synthetic antioxidants. In this context, our study was undertaken to assess biological properties of Styphnolobium japonicum used in traditional medicine to treat many diseases.

Methods: The aim of this work was to estimate the total phenolic (TPC), flavonoids (TFC) content and tannins of seed extracts: crude extract (CrES), ethyl acetate (EAES) and aqueous (AqES) fractions, as well their antioxidant, antihemolytic, antithrombotic and anti-inflammatory activity.

Results: The results showed that EAES has the highest amounts of TPC, TFC and Tannins. Antioxidant potential of different extracts has been investigated in vitro using several methods. EAES possesses the strongest antioxidant capacity in scavenging ABTS and hydrogen peroxide free radicals, reducing power activity and has the ability to inhibit the hemolysis of red blood cells. All extracts prevent blood clotting even after three hours at doses 50 and 100 mg/mL, and have significant thrombolytic activity. Moreover, the anti-inflammatory potential of different extracts was evaluated using the inhibition of albumin denaturation test at a concentration of 2, 1, 0.5 and 0.25 mg/mL. This anti-inflammatory activity was dose-dependent and was significant for EAES and CrES.

Conclusion: These results demonstrate Styphnolobium Japonicum species' potential as a valuable source of bioactive chemicals with strong antioxidant and anti-inflammatory properties, and support its traditional use in treating various diseases.

Keywords: *Styphnolobium japonicum, Polyphenols, Flavonoids, Antioxidant activity, Anti-thrombotic activity, Anti-inflammatory activity.*

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Occurrence of Anisakis spp. in *Pagellus bogaraveo* from the Mediterranean: Ecological and Zoonotic Insights

Lamia Lablack[1,3]*, Fatima Benhamou[2], Douniazed Marzoug[3]

[1] Higher School of Biological Sciences of Oran (HSBSO), Environmental Surveillance Network Laboratory (LRSE), Algeria
[2] Département d'Ecologie et environnement, Faculté des sciences naturelles et de la vie et des sciences de la terre et de l'univers, Université Aboubekr Belkaid, Tlemcen,
[3] Department of Biology, Faculty of Natural and Life Sciences, University of Oran 1, Environmental Surveillance Network Laboratory (LRSE), Algeria

Background and Aim: Nematodes of the genus Anisakis are of notable ecological and medical significance. They contribute to marine food web dynamics but also represent a zoonotic hazard, as humans may become accidental hosts through the consumption of raw or undercooked fish, leading to anisakiasis. This study investigated the occurrence, prevalence, and morphological identification of *Anisakis* larvae in *Pagellus bogaraveo* from the Mediterranean Sea and assessed their public health implications.
Methods: A total of 315 specimens of P. bogaraveo were examined. The gastrointestinal tract and visceral cavity were dissected to recover larvae. Morphological identification was performed using light microscopy and scanning electron microscopy (SEM), following Berland's (1961) classification criteria distinguishing type I and type II larvae based on ventricle morphology and the presence of a posterior mucron.
Results: In P. bogaraveo, type I larvae showed a prevalence of 10.16%, mean abundance of 0.22, and mean intensity of 2.19 (32 infected fish). Type II larvae were less frequent, with 1.59% prevalence, mean abundance of 0.02, and mean intensity of 1.20 (5 infected fish). Larvae were localized in the stomach, intestine, caeca, liver, mesenteries, and visceral cavity. SEM confirmed diagnostic features, including anterior boring teeth and posterior mucron structures.
Conclusion: This study provides the first record of Anisakis spp. in P. bogaraveo from the Mediterranean Sea. The higher prevalence of type I larvae highlights interspecific differences in host–parasite associations. Beyond ecological insights, the results emphasize the zoonotic potential of Anisakis spp., whose life cycle involves crustaceans as first intermediate hosts, fish and cephalopods as paratenic hosts, and marine mammals as definitive hosts. Humans, as accidental hosts, may develop gastrointestinal or allergic anisakiasis. These findings highlight the importance of molecular confirmation to refine species identification and better evaluate risks for food safety and public health.
Keywords: *Anisakis, Pagellus bogaraveo, Host–parasite interaction, Anisakiasis, Zoonosis.*

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Investigation of Strongyloidiasis Transmission from Infected Mother to Newborn Postpartum

Mahdieh Sorouri Majd[1,2*], Zohreh Fakhrieh Kashan[1,2], Eshrat Beigom Kia[1], Somayeh Mousavi Mobarakeh [1], Seyedeh Hajar Sharami [3], Azadeh Jafari [3]

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[2] Student's Scientific Research Center, Tehran University of Medical Sciences, Tehran, Iran
[3] Reproductive Health Research Center, Department of Obstetrics & Gynecology, Al-Zahra Hospital, School of Medicine, Guilan University of Medical Sciences, Rasht, Iran

Background and Aim: Strongyloidiasis is a disease caused by the soil-transmitted nematode Strongyloides stercoralis. It is considered a neglected disease that can lead to long-term disability, growth retardation in children, complications during pregnancy, and adverse effects on the fetus. In this study, we examine a case of strongyloidiasis in a newborn born to a mother infected with confirmed strongyloidiasis during pregnancy, diagnosed by serological, parasitological, and molecular methods.
Case Presentation: A 38-year-old woman at 35 weeks of gestation from a rural area in Rasht, Guilan province, Iran, presented with gastrointestinal symptoms (diarrhea, abdominal pain) and severe dyspnea since the fourth month of pregnancy. Her medical history included hypothyroidism and a pituitary microadenoma. With limited literacy and daily soil contact through agricultural work, she was at high risk for soil-transmitted infections. She reported contact with a pet cat and inadequate vegetable hygiene practices. Laboratory findings revealed a peripheral blood eosinophil count of 2%. Stool examination (direct smear, formalin-ethyl acetate concentration, and agar plate culture) and serological testing (ELISA for *S. stercoralis* antibodies) confirmed strongyloidiasis, further validated by molecular methods. Due to potential risks of anti-helminthic drugs during pregnancy, treatment was deferred until one month post-delivery, after breastfeeding cessation. The newborn's stool and breast milk were tested parasitologically and molecularly one month after birth, with negative results, indicating no infection.
Conclusion: Pregnant women are a high-risk group for strongyloidiasis due to pregnancy-related immunosuppression, increasing the potential for disseminated infection, which poses significant maternal and fetal risks. Given the adverse effects of antiparasitic treatment during pregnancy, routine serological screening for S. stercoralis in women before pregnancy in endemic areas is recommended to enable early intervention and mitigate complications, safeguarding maternal and fetal health.
Keywords: *Strongyloides stercoralis, Pregnant women, Neonate, Iran*

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CAR-Engineered Natural Killer Cells: Shaping the Future of Cancer

Manal M E Ahmed

Pharmacology Department, Medical Research and Clinical Studies Institute,
National Research Centre, Giza, Egypt

Background: Chimeric antigen receptor (CAR) technology has revolutionized cancer therapy, and natural killer (NK) cells are rapidly emerging as the next-generation platform in this field. Unlike T cells, NK cells combine antigen-specific targeting with innate cytotoxicity while minimizing the risks of graft-versus-host disease and severe cytokine release syndrome—two major limitations of CAR-T therapy. This unique safety and efficacy profile positions CAR-NK cells as an innovative and transformative therapeutic strategy.

Methods: Recent clinical trials have reported encouraging outcomes in hematologic malignancies, and efforts are now directed toward tackling the greater challenge of solid tumors. The availability of diverse NK cell sources—including peripheral blood, umbilical cord blood, and induced pluripotent stem cells—offers scalable "off-the-shelf" solutions that may broaden patient access worldwide. However, hurdles remain, such as limited persistence, immunosuppressive tumor microenvironments, and manufacturing complexities.

Results: To address these challenges, researchers are pioneering strategies such as cytokine armoring, checkpoint blockade, and multiplex genetic engineering to enhance durability and overcome resistance. With these innovations, CAR-NK cell therapy is poised not only to complement but potentially to surpass existing immunotherapies, offering a safer, more universal, and highly adaptable approach to cancer treatment.

Conclusion: This review provides an updated perspective on the development, advantages, and current challenges of CAR-NK cells, underscoring their lower toxicity, "off-the-shelf" potential, and applicability in both blood cancers and solid tumors. Technological innovations, clinical trials, and synthetic biology strategies are also explored, highlighting the future trajectory of CAR-NK therapies.

Keywords: *CAR-NK cells, Immunotherapy, Cancer, Genetic engineering, Next-generation therapeutics*

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Possible Neonatal Post-COVID-19 Coagulopathy Presenting with Convulsions: A Case Report

Vera Beca*, Mirela Rista, Daniela Nakuci, Eliona Demaliaj

University Hospital of Obstetrics and Gynecology 'Queen Geraldine', Tirana, Albania

Background and Aim: Although COVID-19 in neonates is generally mild, emerging evidence suggests possible post-infectious complications, including coagulopathy and neurological manifestations. Maternal SARS-CoV-2 infection during pregnancy may trigger immune-mediated or thrombotic responses in the newborn.
Methods: We present a case of a full-term male neonate, born via cesarean section to a mother with a history of COVID-19 infection during pregnancy. Clinical, laboratory, and imaging findings were evaluated to identify the underlying cause of neonatal convulsions and coagulopathy.
Results: On the fourth day of life, the newborn developed partial convulsions, fever, and desaturation. Laboratory tests revealed elevated D-dimer levels, while other coagulation parameters were normal. Neuroimaging showed intraventricular hemorrhage without parenchymal involvement. Common causes such as sepsis, perinatal asphyxia, and disseminated intravascular coagulation were excluded. The neonate was treated with fresh frozen plasma, steroids, antibiotics, vitamin K, and oxygen therapy, showing complete clinical recovery.
Conclusion: This case supports the hypothesis of a possible neonatal post-COVID-19 coagulopathy related to maternal infection. Neonatologists should consider this condition in newborns presenting with seizures or hemorrhagic signs and maternal COVID-19 exposure. Further studies are needed to define diagnostic criteria and management guidelines.
Keywords: *Neonatal coagulopathy, COVID-19, Maternal SARS-CoV-2 infection, Convulsions*

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Smart Nanomaterials for Targeted Drug Delivery and Controlled Release in Cancer Therapy

Atefeh Hasanli

Department of Nanobiotechnology, Faculty of Biological Science,
Tarbiat Modares University, Tehran, Iran

Background and Aim: The development of smart nanomaterials for targeted drug delivery and controlled release in cancer therapy has emerged as a critical strategy to enhance therapeutic efficacy while reducing systemic toxicity. This review aims to examine the advancements in nanocarrier systems, including mesoporous silica nanoparticles, magnetic nanocomposites, liposomes, micelles, dendrimers, and nucleic acid-based nanostructures, focusing on their stimuli-responsive mechanisms and targeting capabilities.
Methods: A comprehensive literature survey was conducted analyzing recent studies on smart nanomaterials designed for cancer therapy. The review emphasizes design strategies for stimuli-responsive drug release, multifunctionality, and tumor microenvironment targeting, integrating knowledge from polymer science, nanotechnology, and molecular biology.
Results: Mesoporous silica nanoparticles showcase tunable pore structures facilitating controlled drug release and prevention of premature release. Magnetic nanocomposites combine hyperthermia with pH- and thermo-responsive delivery, enabling external manipulation of drug release. Stimuli-responsive surface modifications, such as light-triggered wettability changes, provide spatial and temporal control. Co-delivery systems enhance efficacy by targeting multiple pathways, with polymer scaffolds supporting sustained localized delivery. Additionally, DNA nanomaterials enable precision gene therapy through disassembly triggered by cellular cues.
Conclusion: The convergence of stimuli-responsive design, multifunctionality, and precise targeting in smart nanomaterials presents promising advances for cancer therapy. Tailoring nanocarrier properties to exploit tumor microenvironment conditions and external stimuli enhances drug delivery precision and safety. Future research should aim to optimize scalability, biocompatibility, and clinical translation.
Keywords: *Smart nanomaterials, Targeted drug delivery, Controlled release, Cancer therapy, Mesoporous silica nanoparticles, Magnetic nanocomposites, Stimuli-responsive, Nanotheranostics, Polymer scaffolds, DNA nanomaterials*

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Stem Cells in Personalized Tissue Engineering

Mehnoush Ebadi

Department of Engineering, Bioengineering Campus, University of Genova, Italy

Background and Aim: Over the past ten years, tissue engineering has made great progress, and stem cells are essential for the regeneration and repair of damaged tissues. Customizing regeneration techniques for each patient through personalized tissue engineering has enormous potential to enhance clinical results. However, because of differences in cell activity, scaffold compatibility, and immune response, there are still difficulties in converting stem cell therapies into customized solutions. The purpose of this review is to examine the function of stem cells in customized tissue engineering and evaluate current developments, significant obstacles, and potential future paths.

Methods: Web of Science, PubMed, and Scopus databases were used to do a systematic literature review. "Stem cells," "individualized tissue engineering," "regenerative medicine," "biomaterials," and "patient-specific scaffolds" were among the keywords. Included were articles written in English and released between 2020 and 2025. Relevance to patient-specific modeling, scaffold design, therapeutic applications, and stem cell sources were taken into consideration while choosing studies. AI-based methods for patient assessment and design optimization were also taken into account.

Results: Recent research shows that mesenchymal stem cells, induced pluripotent stem cells, and embryonic stem cells can all be used to create tissues that are unique to each patient. The accuracy and versatility of synthetic tissues have increased thanks to developments in 3D bioprinting, computational modeling, and AI-assisted scaffold design. Long-term integration, vascularization, and immunological tolerance are still difficult to achieve despite advancements.

Conclusion: The future of customized tissue engineering depends heavily on stem cells. The development of customized regenerative therapies is being accelerated by integration with AI-driven technologies and biomaterial innovation, opening the door to more efficient and customized patient care.

Keywords: *Stem Cells, Personalized Tissue Engineering, Regenerative Medicine, Biomaterials, 3D Bioprinting*

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Advances in Selenium Nanoparticles for Targeted Cancer Therapy: Mechanisms and Clinical Potential

Tahereh Ghaderi Barmi

Department of Biology, Faculty of Medical Sciences, Islamic Azad University, Tehran, Iran

Background and Aim: Cancer remains a leading cause of global mortality, demanding novel therapeutic approaches beyond conventional treatments. Nanotechnology-based strategies, particularly selenium nanoparticles (SeNPs), have emerged as promising tools due to their excellent bioavailability, low toxicity, and selective targeting ability. This review aims to summarize recent advancements in SeNP synthesis, surface functionalization, and therapeutic potential in cancer treatment.

Methods: A systematic review of recent peer-reviewed literature was conducted to evaluate SeNP design, functionalization strategies, and applications in targeted drug delivery and autophagy regulation related to cancer therapy.

Results: SeNPs exhibit strong antioxidant and anticancer properties and can serve both as therapeutic agents and nanocarriers for drug delivery. Functionalization with biomolecules enhances tumor-specific targeting and cellular uptake, improving bioavailability and reducing systemic toxicity. SeNPs also regulate autophagy signaling, offering therapeutic potential through alternative cell death pathways such as necroptosis and ferroptosis. Despite remarkable laboratory success, clinical translation remains limited due to challenges in nanoparticle stability and large-scale production.

Conclusion: Selenium nanoparticles represent an innovative platform for precision cancer therapy, combining targeted delivery, reduced toxicity, and enhanced therapeutic efficacy. Continued research on optimization and clinical validation is essential to realize their full potential as next-generation nanomedicines.

Keywords: *Selenium nanoparticles, Cancer therapy, Targeted drug delivery, Autophagy regulation, Nanomedicine*

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The Inhibitory Effects of Green Synthesized Selenium Nanoparticles on Migration of Ovarian Cancer (OVCAR-3) Cells

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Background and Aim: Ovarian cancer remains a leading cause of cancer-related mortality among women, with metastasis driven largely by cancer cell migration and proliferation. Selenium nanoparticles (SeNPs), especially those synthesized via green methods, have shown promise as potential anti-cancer agents. This study aimed to evaluate the effects of SeNPs, green synthesized using Onopordum acanthium extract, on the migration and proliferation of OVCAR-3 ovarian cancer cells.
Methods: SeNPs were biosynthesized using *Onopordum acanthium* extract and applied to cultured OVCAR-3 cells. A scratch (wound healing) assay was performed to assess cell migration and proliferation over 72 hours in both treated and untreated control groups. Images were captured at 0 and 72 hours to qualitatively evaluate wound closure.
Results: In the control group, OVCAR-3 cells showed extensive migration and/or proliferation, resulting in near-complete closure of the scratch area after 72 hours. In contrast, the SeNP-treated cells exhibited significantly reduced wound closure, with the scratch area remaining visibly open and only partially filled by migrating/proliferating cells. These observations suggest that SeNPs significantly inhibit the migratory and proliferative capabilities of OVCAR-3 cells.
Conclusion: Green-synthesized selenium nanoparticles using Onopordum acanthium extract effectively suppress cell migration and proliferation in OVCAR-3 ovarian cancer cells in vitro. This indicates their potential as anti-metastatic agents in ovarian cancer therapeutics. Further quantitative and mechanistic studies are warranted to validate these findings.
Keywords: *Selenium nanoparticles, Green synthesis, Onopordum acanthium, OVCAR-3, Cell migration inhibition*

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Protective Effect of Vitamin E on Testicular Gland and Serum Testosterone Levels in Adult Male Rats Treated with Hydroalcoholic Extract of *Vitis vinifera* Leaves

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Background and Aim: Grapevine leaves (Vitis vinifera), due to their polyphenolic compounds and antioxidant properties, may influence the reproductive system. Vitamin E, with its strong antioxidant capacity, plays a significant protective role in reproductive gland function. This study aimed to investigate the protective effect of vitamin E on the testicular glands and serum testosterone levels in adult male rats treated with hydroalcoholic extract of grapevine leaves.
Methods: In this experimental study, 36 adult male Wistar rats were randomly divided into control, grapevine leaf extract (200 and 400 mg/kg), vitamin E (5 mg/kg), and two combination groups receiving both vitamin E and the extract at either dose. Treatments were administered for 28 days and at the end of the study, body weight, testis weight, and serum testosterone levels were measured. Data were analyzed using one-way ANOVA.
Results: Treatment with grapevine leaf extract at both doses significantly reduced body weight and serum testosterone levels compared to the control group ($P<0.05$). Co-administration of vitamin E and the extract showed a partial improvement in body weight and testosterone levels but did not return to control levels. Vitamin E alone significantly increased serum testosterone levels compared to the control and extract-treated groups ($P<0.05$). No significant difference was observed in testis weight among the groups.
Conclusion: Vitamin E, due to its antioxidant properties, can partially mitigate the adverse effects of grapevine leaf extract. However, simultaneous administration of the two substances may negatively affect testosterone production, suggesting the need for further investigation.
Keywords: *Grape leaf, Vitamin E, Testosterone, Hydroalcoholic extract, Adult male rat*

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Assessment of the Hemostatic and Wound Healing Properties of *Heliotropium europaeum*

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Background and Aim: This study aimed to rigorously evaluate the in vivo wound healing and hemostatic properties of Heliotropium europaeum (heliotrope), leveraging its documented antioxidant activity. A standardized excision wound model was employed in rats, creating uniform superficial wounds.
Methods: These were treated topically with a hydroalcoholic extract of heliotrope, with healing progression compared against a negative control and a marketed reference product. Parameters measured included wound contraction rate, epithelialization period, and histopathological analysis.
Results: The heliotrope extract demonstrated immediate hemostatic action, significantly reducing bleeding time upon application. Furthermore, it accelerated wound closure, achieving complete epithelialization faster than both the control and the reference product. This enhanced efficacy is attributed to a synergistic combination of the plant's bioactive constituents, which likely promote coagulation, scavenge free radicals, and inhibit microbial growth.
Conclusion: These findings robustly confirm the pharmacological potential of H. europaeum for developing advanced dermatological applications, including therapeutic wound care agents and regenerative cosmetic products.
Keywords: *Heliotropium europaeum, Hemostatic, Wound healing*

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Herbal Topicals in Pain Management: A Narrative Review of Recent Clinical Trials and Key Considerations for Future Studies

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Background and Aim: Pain affects nearly one in five adults worldwide. While long-term use of NSAIDs and opioids is associated with significant side effects, non-topical routes also result in higher systemic absorption. These challenges have led to growing interest in topical plant-derived preparations. The unclear mechanisms of many such products highlight the need for more research. This narrative review aimed to identify limitations, considerations, and key gaps in previous clinical trials to guide future studies.

Methods: A non-systematic search of 74 keywords was conducted in PubMed, ScienceDirect, and Cochrane. Eligible studies were clinical trials assessing topical herbal preparations on pain, as measured by scales. Exclusion criteria were non-topical administration, unclear outcomes, reviews, and irrelevant topics. From 3,316 records, 1,683 remained after limiting the search to 2017–2025; 140 were clinical trials, of which 56 met inclusion criteria. The review was structured using the JBI checklist for narrative reviews.

Results: Of 56 trials, capsaicin (34%) and menthol (10.7%) were the most frequently investigated topical herbal agents, while licorice and arnica were least studied (1.7% each). The most common pain assessment tools were VAS (48%) and NRS (27%). Findings on menthol, capsaicin, and aloe vera were contradictory across some studies. Nanogel formulations significantly enhanced absorption of curcumin and clove eugenol. Negative interactions were reported when menthol was mixed with capsaicin, diclofenac, or methyl salicylate. Major limitations included difficulties in blinding due to distinctive odor or color, absence of herb–drug interaction assessments, and lack of long-term follow-up.

Conclusion: While topical herbal agents like capsaicin and menthol show efficacy for pain relief, methodological limitations and inconsistent findings emphasize the need for standardized formulations, robust clinical trials, smart blinding, and long-term safety assessments.

Keywords: *Herb, Phytotherapy, Analgesia, Topical*

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Prevalence of Self-reported Food Allergies in Tunisia: General Trends and Probabilistic Modeling

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Background and Aim: Food allergy (FA) is a growing public health concern affecting millions worldwide. In Tunisia, data on the prevalence and characteristics of FA are limited, underscoring the need for targeted research.

Methods: This study sought to fill this gap by estimating the prevalence of self-reported food allergies in the Sfax region of Tunisia. A bilingual questionnaire was administered to 125 children (56% males, aged 1–17 years) and 306 adults (17% males, aged 18–70 years).

Results: We identified 105 self-reported food allergens classified into eight groups: fruits, seafood, eggs, milk and dairy, cereals, nuts, vegetables, and peanuts. Cutaneous symptoms were the most common in both children and adults. Family history of FA was reported by 40% of children and 30% of adults. Additionally, 81% of adults and 38% of children were allergic to at least one non-food allergen. Fruits were the most prevalent food allergen in both age groups, followed by seafood. Most allergies were mutually exclusive, with 90% of participants reporting only one food allergy. To explore the relationships among reported allergies, a Bayesian network model estimated the conditional probabilities of co-occurrence.

Conclusion: The prevalence of self-reported food allergies in Tunisia appears linked to dietary habits and food availability, as the most frequent allergens are foods commonly consumed by the population.

Keywords: *Food allergy, Prevalence, Probabilistic modeling, Self-reported survey, Tunisia*

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Evaluation of Rapeseed Oil as a Functional Fat Replacer in Biscuits Using Phytochemical and Fluorescence Spectroscopic Methods

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Background and Aim: Global trends toward healthier diets are driving the replacement of palm oil with more sustainable and nutritious oils in baked goods. Rapeseed oil offers a promising alternative thanks to its favourable fatty acid profile. However, its high level of unsaturation makes it susceptible to oxidation, which compromises quality and shelf life. The current study aimed to investigate the replacement of palm oil with rapeseed oil in biscuits, as well as the protective effects of the synthetic (butylated hydroxytoluene, BHT) and the natural (pomegranate peel extract, PPE) antioxidants during 96 days of storage.
Methods: Water activity, moisture content, colour, texture, peroxide value, and TBARS were monitored. Fluorescence spectroscopy coupled with principal component analysis (PCA) was used to track molecular changes. Data were analyzed using XLSTAT 2016.
Results: Rapeseed oil alone was most susceptible to lipid oxidation, while both BHT and PPE significantly moderated oxidative deterioration. NADH emission spectra showed a decline at ~470 nm and an increase at ~562 nm during storage, consistent with oxidation-induced conversion of NADH to NAD+. Progressive increases in Vitamin A fluorescence at ~345 nm were found, indicating the accumulation of oxidation products. PCA confirmed clear sample discrimination: NADH spectra explained 97% of the variance, separating samples by formulation and storage time, while Vitamin A spectra explained 96%, distinguishing by oil type and ageing.
Conclusion: The study revealed that rapeseed oil can replace palm oil in biscuits when combined with antioxidants, with PPE emerging as an effective clean-label strategy to enhance oxidative stability. Front-face fluorescence spectroscopy, combined with PCA, proved to be a powerful non-destructive tool for monitoring molecular changes associated with oxidation.
Keywords: *Palm oil replacement, Rapeseed oil, Lipid oxidation, Biscuit, Pomegranate peel extract, Fluorescence, Principal component analysis*

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Formulation of Olive Oil–Beeswax Bigel

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Background and Aim: Margarine is a consumer product that is sometimes substituted to butter due to its lower price and its physical properties. Margarine is obtained from the hydrogenation of vegetable oils, resulting primarily in trans and saturated fatty acids. To eliminate harmful trans fatty acids and reduce saturated fatty acids in foods, oleogelation technology was developed. The aim of this work concerns the formulation of different bigels and their characterization. Physicochemical and organoleptic characterization of the formulated bigels were compared with a commercial olive oil margarine.
Methods: Four bigels were formulated with olive oil and different concentrations of beeswax. The physicochemical characteristics concern the oil exudation capacity, acidity, color, carotenoids and texture of bigels. The stability of the bigels was studied during cold storage for 34 days. Organoleptic characterization concerns seven parameters: color, brightness, odor, hardness, spreadability, taste of olive oil and overall appreciation.
Results: In this study, the bigels exhibited solid properties at room temperature and demonstrated a desirable physicochemical, textural, and sensory profile for food applications. Its overall appearance was found to be relatively similar to commercial olive oil margarine.
Conclusion: Olive oil bigel has a desirable physicochemical, textural, and sensory profile for food applications. The olive oil-beewax bigel could be a potential alternative to margarine, which has harmful properties for health.
Keywords: *Olive oil, Margarine, Beewax, Bigel*

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Potential Anticancer Effects of Diclofenac in Human Pancreatic Cancer Cells

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Background and Aim: Pancreatic ductal adenocarcinoma (PDAC) is one of the most aggressive and lethal gastrointestinal malignancies, characterized by poor prognosis and limited therapeutic options. Diclofenac, a nonsteroidal anti-inflammatory drug (NSAID), has recently been investigated for its potential anticancer properties. This study aimed to evaluate the cytotoxic effects of diclofenac on human pancreatic cancer cells and to assess its potential as an adjuvant therapeutic candidate.
Methods: An in vitro study was conducted using cultured human pancreatic carcinoma cells maintained in standard DMEM medium. The cells were treated with varying concentrations of diclofenac (31.25–500 µg/mL) for 24 hours. Cell viability was measured using the MTT assay, and the half-maximal inhibitory concentration (IC_{50}) was determined from the dose–response curve using GraphPad Prism software. Statistical analysis was performed using one-way ANOVA followed by Tukey's post hoc test.
Results: Diclofenac treatment significantly and dose-dependently reduced pancreatic cancer cell viability ($P < 0.001$). The IC_{50} value was calculated to be 96 µg/mL, demonstrating a strong cytotoxic effect of diclofenac after 24 hours of exposure.
Conclusion: Diclofenac exhibits significant cytotoxic and potential anticancer activity against human pancreatic carcinoma cells in vitro. These findings suggest its possible role as an adjuvant compound in pancreatic cancer therapy. Further mechanistic, preclinical, and clinical studies are warranted to confirm its therapeutic efficacy and safety.
Keywords: *Pancreatic cancer, Diclofenac, Cytotoxicity, Human pancreatic carcinoma cells, Anticancer activity*

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Analytical Equivalence between Manual and Automated Methods for Four Common Biochemical Parameters

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Background and Aim: Manual methods using spectrophotometers are still relevant alternatives to automated analyzers in clinical labs, especially where resources are limited or equipment is unavailable. Automation ensures high throughput and reduces operator variability, but manual approaches remain important. This study evaluates the analytical agreement between manual (spectrophotometric) and automated methods for measuring urea, creatinine, total cholesterol, and triglycerides, aiming to confirm if both can be used interchangeably without accuracy loss.
Methods: A retrospective comparative study was performed at CRAMER laboratory over 45 days with 113 patient samples covering diverse clinical conditions. Each sample underwent duplicate testing using both manual spectrophotometric and automated clinical chemistry analyzers under routine settings. The parameters analyzed were urea, creatinine, cholesterol, and triglycerides. Data were processed with descriptive statistics and paired tests for mean differences and concordance assessment, with significance set at $p \leq 0.05$.
Results: The study population had a mean age of 56.4 ± 15.1 years, with a majority of participants aged between 40 and 80 years. Females represented 67% of the cohort, reflecting the laboratory's patient demographics. No statistically significant differences were observed between the two methods for any of the four parameters ($P \leq 0,05$). The high degree of concordance suggests that both methods produce analytically equivalent results under the tested conditions.
Conclusion: This study demonstrates that manual and automated methods yield comparable results for the measurement of urea, creatinine, cholesterol, and triglycerides. The findings support the reliability of manual techniques as a valid alternative when automated systems are unavailable or impractical. This equivalence enhances operational flexibility in clinical laboratories, particularly in contexts involving equipment maintenance, budget constraints, or temporary workload increases. These results may inform method validation protocols and quality assurance practices in medical biology laboratories.
Keywords: *Automate, Cholesterol, Creatinine, Spectrophotometer, Triglycerides, Urea*

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Biotechnological Valorization of *Rosmarinus officinalis* Extract as a Natural Alternative to Synthetic Nitrites and Nitrates for Improving the Quality and Safety of Processed Meat Products

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Background and Aim: Plant extracts are sustainable bioresources rich in bioactive compounds with antioxidant and antimicrobial properties, making them valuable in green food biotechnology. This study evaluated the effectiveness of Rosmarinus officinalis (rosemary) extract as a natural preservative in salami, aiming to partially replace synthetic nitrites and nitrates. The findings highlight rosemary's potential as a natural preservative that enhances the quality, safety, and sustainability of processed meat products.
Methods: Formulations of transformed meat were prepared, incorporating 0.1% dried green rosemary extract, and stored at 4°C for 90 days. A comparison was made to a control formulation containing 0.6% commercial nitrate/nitrite salts. The preservative effect was exhaustively evaluated by periodic analyses of physicochemical, microbiological and sensory parameters throughout storage.
Results: The results of the experimental showed that Microbiological assessment demonstrated that the rosemary-treated salami significantly ($p < 0.05$) suppressed the proliferation of spoilage and pathogenic microorganisms. Specifically, a marked inhibition was observed in total viable counts, total coliforms, fungi (yeasts and molds), and *Salmonella* spp. compared to the control. Physicochemical, the rosemary extracts effectively stabilized color parameters, preventing undesirable oxidation and maintaining consumer-preferred attributes. Furthermore, the reformulation successfully substituted 0.6% nitrate/nitrite with 0.1% rosemary extract, resulting in a net shelf-life extension of 10 days beyond that of the commercial preservative benchmark, as determined by microbial load and quality degradation endpoints. Sensory evaluation confirmed that the application of rosemary extract did not compromise the product's desirable organoleptic properties, including flavor and texture.
Conclusion: The findings indicate that *Rosmarinus officinalis* extract functions as a multi-functional natural preservative, capable of controlling microbial growth, maintaining critical quality parameters, and extending shelf-life. This study confirms the viability of rosemary extract as a natural and effective alternative to artificial preservatives in meat products, aligning with consumer demand for clean-label ingredients without sacrificing safety or quality.

Keywords: *Rosmarinus officinalis, natural preservatives, antioxidant activity, antimicrobial properties, green food biotechnology, sustainable bioresources*

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Antigen-Targeted CAR Treg + CD25-Biased Low-Dose IL-2 to Enable Calcineurin Inhibition Minimization After Living-Donor Kidney Transplantation

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Background and Aim: The persistent high use of CNIs in preventing allograft rejection can lead to impaired Treg function and unstable FOXP3 expression putting the patient at higher risk of nephrotoxicity, infection, and potential malignancy. This paper proposes a theoretical model of LD-IL-2 conditioning of engineered anti HLA-A2 CAR Tregs to allow localized immunosuppression and prevent CNI toxicity.
Methods: Isolation and transduction of CD4+ CD25^hi^FOXP3+ Tregs with an anti HLA-A2 CAR construct containing CD28/CD3 costimulatory domains to promote CD25 (IL-2R) signaling. After transduction, the CAR Tregs will be cultured in LD-IL-2 to stimulate exogenous cytokine support under CNI induced IL-2 depletion. Theoretical assessment of phenotypic stability to confirm CAR Treg function and stability.
Results: IL-2 conditioning is expected to maintain FOXP3+ stability and enhance CAR Treg persistence to show stronger suppression of HLA-A2 Teff proliferation and cytokine leakage. In transplant settings, this approach may increase Treg: Tconv ratios, reduce serum IL-6 and IFN-y and improve graft histology and renal function.
Conclusion: This proposed model offers a feasible and mechanistically grounded approach to minimize CNI usage while preserving graft tolerance. Furthermore, it highlights a potential shift toward precision immunomodulation, where cytokine guided cellular therapies maintain long term immune balance with reduced system toxicity.
Keywords: *CAR Tregs, Low-dose IL-2, Calcineurin inhibitors immune tolerence, kidney transplantation*

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Altered Response to Targeted Immunotherapy in Metastatic Breast Cancer: The Role of Molecular Signaling Networks

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Background and Aim: Metastatic Breast Cancer (MBC) remains a major clinical challenge due to its high rate of mortality, heterogeneity, as well as a limited long-term response to current therapies. Hence, it seems that there is an imperative need to search for more efficient clinical procedures against MBC, through a deeper understanding on some common molecular immunopathophysiological pathways involved in the Tumor Microenvironment (TME) of MBC.

Methods: This review focuses on dysregulated signaling networks, including mutations in PI3K/AKT/mTOR, MAPK/ERK, HER2/EGFR, and JAK/STAT pathways, which play a central role in fostering immune evasion (by reducing antigen presentation), impairing T-cell infiltration (by enhancing PD-L1 expression), modulating tumor-immune crosstalk (by affecting checkpoint blockade

responsiveness), and impairing cytotoxic immune activation (by disrupting interferon signaling), respectively.

Results: As direct consequences, tumor progression, recurrence, relapse, and therapeutic resistance are expected. Although targeted therapies such as HER2 inhibitors, CDK4/6 inhibitors, and PI3K inhibitors have improved optimized clinical outcomes for patients with MBC, both primary and acquired resistance frequently emerge through secondary mutations, pathway cross-talk (emerged as multiple primary tumors or syndromes or second primary malignancies), and metabolic or epigenetic reprogramming. Similarly, while immune checkpoint inhibitors have shown promise, particularly in triple-negative breast cancer, their efficacy is restricted by TME factors, variable PD-L1 expression, and immune escape mechanisms. Recent evidence suggests that rational combinations of targeted therapy and immunotherapy may overcome resistance by enhancing tumor immunogenicity and restoring anti-tumor immune responses.

Conclusion: Identifying predictive molecular biomarkers and integrating multi-omics approaches will be essential to guide personalized treatment strategies. This review highlights the interplay between signaling cascades and therapeutic response in MBC, emphasizing the need for combinatorial and precision-based approaches to improve clinical outcomes.

Keywords: *Metastatic Breast Cancer, Signaling Networks, Targeted Immunotherapy, Resistance, Molecular Biomarkers, Precision Medicine*

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Critical Roles of Molecular Signaling Pathways in Multiple Primary Tumors: A Missing Piece in the Puzzle of Breast Cancer Precision Medicine

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Background and Aim: Despite advances in state-of-the-art technologies for diagnosis, prognosis, and clinical management, breast cancer remains a malignancy with high morbidity, and a remarked tumor heterogeneity, among which, germline-driven Multiple Primary Tumors (MPTs) represent distinct molecular entities with critical implications. Frequently, MPTs are misclassified as metastatic lesions by gynecologists or gyneco-oncologists, leading to diagnostic inaccuracies, unoptimized clinical outcomes, as well as recurrence.
Methods: Approximately 5–10% of breast cancers arise from BRCA1/2-related Hereditary Breast and Ovarian Cancer (HBOC), TP53-mutated Li-Fraumeni syndrome, PTEN-associated Cowden syndrome, STK11-driven Peutz-Jeghers syndrome, and CHEK2 or ATM-mediated susceptibility. These germline alterations converge on central molecular pathways—DNA Damage Response (DDR), Homologous Recombination Repair (HRR), PI3K/AKT/mTOR, and p53 signaling—governing genomic integrity, cell survival, and apoptosis resistance.
Results: At the molecular level, BRCA1/2 mutations disrupt HRR and sensitize

tumors to synthetic lethality through PARP inhibition, while TP53 alterations deregulate cell-cycle checkpoints, augmenting tumorigenesis under an oxidative stress. Loss of PTEN hyperactivates PI3K/AKT/mTOR signaling, enhancing oncogenic transcriptional programs and metabolic reprogramming. Likewise, CHEK2 and ATM mutations attenuate DNA damage sensing, leading to chromosomal fragility and cooperative oncogenic signaling. These signaling perturbations not only underpin hereditary tumor initiation, but also lessen the responsiveness to targeted therapeutics and immunomodulatory strategies.

Conclusion: The evolution of translational and molecular medicine has revolutionized breast cancer precision oncology by bridging germline genomics with functional proteogenomics, transcriptomics, and spatial multi-omics. Integrative molecular profiling enables early identification of mutation carriers, dynamic risk prediction, and therapy optimization based on pathway vulnerabilities. Moreover, the convergence of Next-Generation Sequencing (NGS), liquid biopsy technologies, and artificial intelligence-driven modeling is refining the molecular taxonomy of hereditary breast cancer, enabling the transition from genotypic categorization to pathway-oriented, patient-specific clinical interventions, integrating these insights into translational frameworks to establish a paradigm shift in breast cancer care, from population-based management toward molecularly-guided breast cancer precision oncology.

Keywords: *Breast Cancer, Immunopathophysiology, Metastasis, Molecular Medicine, Precision Medicine, Multiple Primary Tumors*

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Exploring Students' Awareness and Attitudes Toward the Use of Artificial Intelligence in Teaching Biology and Its Future Prospects

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Background and Aim: Artificial intelligence (AI) is increasingly being integrated into higher education, yet its adoption and impact in biology teaching remain underexplored. This study aimed to assess university students' perceptions, awareness, and attitudes toward AI applications in biology education, including perceived benefits, risks, and support for curricular integration.
Methods: A cross-sectional survey was conducted among 95 university students enrolled in biological sciences programs. A structured online questionnaire collected data on demographics, familiarity with AI, perceptions of faculty and institutional engagement, attitudes toward AI's future role, and ethical considerations. Responses were analyzed quantitatively, with percentages used to describe distributions across key domains.
Results: Most participants were female (82.1%) and undergraduates (82.1%). Familiarity with AI was generally low to moderate, however, students recognized its value in enhancing understanding of complex concepts (76% reporting moderate to high benefit) and making learning more engaging (80.6%). Students perceived limited faculty and institutional engagement with AI, with low availability of workshops and low motivation from university officials. Concerns regarding potential misuse, reduced interaction, and overreliance on AI were noted, yet most students favored a hybrid approach combining AI with traditional teaching. Notably, 72.4% strongly supported incorporating AI into university curricula.
Conclusion: University students demonstrate cautious optimism toward AI in biology education, appreciating its potential to enhance learning while recognizing associated risks. Effective integration will require targeted faculty training, institutional support, and ethical guidelines to maximize benefits and minimize negative impacts. These findings highlight the importance of embedding AI literacy in higher education to prepare students for evolving technological landscapes.
Keywords: *Artificial intelligence, Biology education, Student perceptions, Curriculum integration, Higher education*

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Autophagy Modulation in Cancer Therapy: Nanomedicine, Pharmacological, and Nutritional Strategies

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Background and Aim: Autophagy, a conserved lysosome-mediated degradation process, plays a dual role in cancer biology—acting as both a tumor suppressor and a survival mechanism for malignant cells. While it maintains cellular homeostasis and genomic stability in early tumorigenesis, excessive or dysregulated autophagy supports cancer cell survival under therapeutic stress. This review aims to summarize recent advances in understanding the role of autophagy in cancer progression, therapeutic resistance, and the emerging potential of autophagy modulation strategies.
Methods: A systematic review of recent peer-reviewed literature was conducted using databases such as PubMed, ScienceDirect, and Frontiers. Studies were screened focusing on autophagy regulation in cancer, nanomedicine-based interventions, pharmacological inhibitors, nutritional modulation, and combination therapeutic approaches.
Results: Findings reveal that autophagy contributes to both suppression and progression of cancer depending on the tumor context. Inhibitors such as chloroquine and hydroxychloroquine enhance the efficacy of chemotherapeutics by blocking autophagy-mediated resistance. Nutritional interventions like intermittent fasting were found to modulate autophagic activity, promoting anticancer effects while protecting normal cells. Moreover, advances in nanotechnology enable targeted delivery of autophagy modulators, improving specificity and reducing systemic toxicity. Crosstalk between autophagy and ferroptosis presents new opportunities for synergistic cancer therapies.
Conclusion: Autophagy represents a complex yet promising therapeutic target in cancer. Strategic modulation—either activation or inhibition—through nanotechnology, pharmacological agents, and nutritional strategies could enhance treatment outcomes. Continued research into the molecular mechanisms governing autophagy and its interaction with other cell death pathways will be critical for clinical translation.
Keywords: *Autophagy, Cancer Therapy, Nanomedicine, Pharmacological Modulation, Nutritional Intervention*

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Effects of Multi-site Non-invasive Brain Stimulation on Cognitive Impairment After Stroke: A Systematic Review

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Background and Aim: Cognitive deficits are a frequent and disabling result of stroke, greatly affecting patients' quality of life and their ability to recover functionally. Non-invasive brain stimulation (NIBS), which encompasses repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS), has risen as a hopeful treatment for cognitive impairments following a stroke. This systematic review seeks to assess the impact of multi-site NIBS methods on cognitive deficits after a stroke.

Method: A comprehensive search was carried out across various databases, such as Web of Science, PubMed, ScienceDirect, and Scopus, for research published from 2015 to the current date. Inclusion criteria included: (1) studies involving adult stroke patients, (2) interventions utilizing multi-site NIBS methods, and (3) outcomes evaluating cognitive performance. Articles were reviewed and chosen according to PRISMA guidelines, and information on stimulation protocols, targeted brain regions, evaluated cognitive domains, and results was gathered.

Results: Numerous studies suggest that multi-site NIBS interventions lead to enhancements in post-stroke cognitive function, especially regarding attention, working memory, and executive functioning. Stimulating specific combinations of brain areas, like the prefrontal and parietal cortices or the cerebellum, seems to boost therapeutic outcomes. Methods that integrate various NIBS techniques, like rTMS and tDCS, demonstrated enhanced and longer-lasting cognitive advantages compared to single-site or single-modality stimulation.

Conclusion: Multi-site NIBS seems to be a promising approach for enhancing cognitive deficits post-stroke, particularly when focusing on interlinked cognitive networks. Nonetheless, additional extensive, standardized studies are required to validate the best stimulation parameters and long-term effectiveness.

Keywords: *Stroke rehabilitation, Cognitive impairment, Non-invasive brain stimulation, rTMS, tDCS*

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Green Chemistry Approaches to Synthesize Biocompatible Nanoparticles for Biomedical Applications

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Background and Aim: The synthesis of biocompatible nanoparticles via green chemistry has gained significant attention due to its eco-friendly and biologically safe nature, providing sustainable alternatives to conventional chemical methods. This review aims to systematically explore recent advancements in green synthesis strategies using biological agents such as plants and microorganisms, highlighting their potential in biomedical applications.

Methods: A comprehensive literature review was conducted focusing on studies published over the last decade that describe nanoparticle synthesis using plant extracts, microbial cultures, and biomolecules. Emphasis was placed on control of nanoparticle physicochemical properties, biocompatibility, functionalization, and application in diagnostics, drug delivery, and therapeutics.

Results: Green synthesis methods utilize plant phytochemicals and microbial enzymes to reduce metal ions, yielding nanoparticles with controlled size, shape, and functional properties. Plant-based extracts are cost-effective, biocompatible, and offer additional bioactive functionalities, enhancing therapeutic potential. Microbial exopolysaccharides provide stabilization and surface modification capabilities. Applications span antibacterial agents, imaging, theranostics, and drug delivery systems. Biocompatibility and reduced cytotoxicity are critical benefits over chemically synthesized nanoparticles.

Conclusion: Green chemistry provides sustainable, efficient pathways for synthesizing biocompatible nanoparticles with versatile biomedical applications. However, challenges remain in large-scale production, precise control over nanoparticle morphology, and detailed pharmacokinetic and toxicity assessments. Ongoing research integrating green synthesis with nanotechnology promises advanced, safer nanomaterials for future biomedical innovations.

Keywords: *Green synthesis, Biocompatible nanoparticles, Plant extracts, Microbial synthesis, Drug delivery, Theranostics, Nanobiotechnology, Biomedical applications*

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Bionanotechnology in Personalized Medicine: Current Challenges and Future Perspectives

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Background and Aim: In customized medicine, bionanotechnology—the fusion of nanotechnology and biology—has become a game-changing instrument. It makes molecular precision diagnostics, early illness diagnosis, and tailored medicine administration possible. Notwithstanding these encouraging uses, a number of obstacles stand in the way of implementing bionanotechnological advancements in clinical settings, such as patient-specific variability, scalability, regulatory barriers, and biocompatibility. The purpose of this review is to examine current developments in bionanotechnology in personalized medicine, pinpoint major obstacles, and suggest future paths for clinical integration.

Methods: A thorough search of the literature was done with Web of Science, PubMed, and Scopus. "Bionanotechnology," "individualized medicine," "nanocarriers," "targeted drug delivery," and "nanosensors" were among the keywords. Articles written in English and released between 2020 and 2025 were included. Studies that exploited bionanotechnological technologies for personalized monitoring, treatment, and diagnostics were the main emphasis of the selection. We also looked at AI-assisted techniques for designing nanomaterials and predicting patient-specific responses.

Results: Numerous applications were found in the review, such as drug delivery systems based on nanoparticles, biomarker detection using nanobiosensors, and diagnostics enabled by nanotechnology customized for each patient's unique profile. The application of AI and machine learning algorithms to forecast treatment results and enhance nanomaterial qualities has grown. Widespread clinical acceptance is nevertheless still constrained by problems like toxicity, customized dosage, and regulatory approval.

Conclusion: Because bionanotechnology allows for precise, patient-specific therapies, it has the potential to completely transform personalized medicine. Transforming bionanotechnological advancements into useful healthcare solutions requires addressing present issues through multidisciplinary research, AI integration, and strong clinical validation.

Keywords: *Bionanotechnology, Personalized Medicine, Targeted Drug Delivery, Nanodiagnostics, Precision Therapeutics*

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Medicinal Plants Native to Iran for the Management of Female Infertility: A Mechanistic Review of Recent Advances

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Background and Aim: Around the world, including in Iran, a sizable percentage of women of reproductive age suffer from infertility. Many people use traditional medicines, especially medicinal herbs, even if there are contemporary fertility treatments available. The use of ethnomedicinal plants for reproductive health has a long history in Iran. Nevertheless, there is still a lack of scholarly assessment of their processes and therapeutic significance. Identifying and summarizing indigenous Iranian medicinal herbs used to treat female infertility with an emphasis on their pharmacological mechanisms and evidence-based efficacy is the goal of this review.
Method: A structured literature search was performed using databases such as PubMed, Scopus, and Google Scholar from 2020 to 2025. AI-assisted tools, including ResearchRabbit and Semantic Scholar, supported screening and analysis. Keywords included: Iranian medicinal plants, female infertility, phytoestrogens, reproductive hormones, and ovarian dysfunction. Inclusion criteria comprised English-language articles from 2020 onward, reporting in vitro, in vivo, or clinical studies on plants native to Iran with relevance to female reproductive health.
Results: Several plants, such as *Vitex agnus-castus*, *Foeniculum vulgare*, *Tribulus terrestris*, and *Cinnamomum verum*, showed potential fertility-enhancing effects. Mechanisms included modulation of the hypothalamic-pituitary-gonadal axis, estrogenic activity via phytoestrogens, antioxidant defense enhancement, and regulation of ovarian folliculogenesis. However, most studies were preclinical, with few clinical trials offering conclusive evidence.
Conclusion: Iranian medicinal plants, mainly through hormonal and antioxidant mechanisms, have promising therapeutic value for treating female infertility. To confirm their safety, effectiveness, and possible incorporation into evidence-based reproductive medicine, more clinical trials and mechanistic research are necessary.

Keywords: *Iranian medicinal plants, Female infertility, Phytoestrogens, Reproductive health, Hormonal regulation*

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Advances and Challenges in Precision Medicine: Translational Approaches and Network Oncology Perspectives from Italian Research Initiatives

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Background and Aim: Precision medicine, integrating genomic, molecular, and clinical data, has transformed personalized healthcare strategies. This review aims to synthesize recent advances and challenges in translational approaches and network oncology within precision medicine as pursued in Italian research contexts.
Method: A structured literature search was performed using databases such as PubMed, Scopus, and Google Scholar from 2020 to 2025. AI-assisted tools supported screening and analysis. Key terms included "precision medicine," "translational research," "network oncology," "Italy," and related synonyms. Inclusion criteria prioritized original research, clinical trials, and reviews focusing on translational and network-based oncology approaches in precision medicine. Articles not in English or not aligned with the thematic scope were excluded.
Results: The study results exhibit significant progress in the implementation of multi-omics data integration, biomarker discovery, and patient stratification models in Italian research contexts. Although improved network oncology approaches have facilitated understanding of tumor heterogeneity and therapeutic resistance, significant challenges remain in data standardization, interdisciplinary collaboration, and equitable clinical translation.
Conclusion: Research in Italian academia have contributed significantly to advancing precision medicine, particularly through translational and network oncology frameworks. Addressing existing challenges can enhance the clinical impact and foster broader adoption of precision strategies. Meanwhile, more research are required to emphasize integrative analytics and collaborative infrastructures to enhance personalized cancer treatment and care.
Keywords: *Precision medicine, Translational research, Network oncology, Biomarkers, Personalized therapy*

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ABSTARCTS

Modulating Hebbian Plasticity via Multi-Site Non-Invasive Brain Stimulation: Implications for Cognitive and Affective Network Functions

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Background and Aim: Hebbian plasticity, known as the principle that "cells that activate simultaneously connect," is essential for learning, memory, and emotional processing. Recent developments indicate that non-invasive brain stimulation (NIBS), especially when targeted at multiple areas, can affect Hebbian processes and impact widespread cognitive and emotional networks. This systematic review seeks to investigate the impact of multi-site NIBS protocols on Hebbian plasticity and their significance for cognitive and affective functions in both healthy individuals and clinical populations.
Methods: A thorough literature review was performed utilizing databases such as Web of Science, PubMed, ScienceDirect, and Scopus for studies published from 2015 to the current date. Studies were eligible if they featured multi-site NIBS (e.g., rTMS, tDCS) aimed at cognitive and/or emotional brain networks, with results pertinent to synaptic plasticity, cognition, or emotion. Screening and selection adhered to PRISMA guidelines, while data on stimulation parameters, targeted areas, and results were gathered and synthesized.
Results: The examined research indicates that multi-site NIBS may improve or revive Hebbian-like plasticity by coordinating or altering activity among linked brain areas. Focused stimulation of prefrontal, parietal, and limbic regions resulted in enhancements in cognitive functions like attention and working memory, alongside emotional regulation. Multi-site methods proved to be more successful than single-site stimulation in activating functional networks and generating lasting neuroplastic changes. Nonetheless, differences in study designs and stimulation protocols continue to pose a limitation.

Conclusion: Multi-site NIBS shows potential for influencing Hebbian plasticity in cognitive and emotional networks. Additional studies are required to improve protocols and elucidate mechanisms for clinical use.

Keywords: *Hebbian plasticity, Non-invasive brain stimulation, Multi-site stimulation, Cognitive networks, Affective regulation.*

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Design and Application of DNA Nanostructures for Biosensing and Molecular Diagnostics

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Background and Aim: DNA nanostructures have emerged as highly programmable and structurally precise platforms with significant potential in biosensing and molecular diagnostics. This review aims to dissect the design principles and applications of DNA-based nanosensors, emphasizing their role in enhancing diagnostic sensitivity, multiplexing capability, and adaptability in complex biological environments.

Methods: A systematic literature review was conducted using databases such as PubMed, Scopus, and Web of Science with keywords including "DNA nanostructures," "biosensing," "molecular diagnostics," "DNA hydrogels," and "CRISPR-based biosensors." Selected studies focusing on structural design, sensing mechanisms, and diagnostic applications of DNA nanotechnologies were critically analyzed.

Results: DNA nanostructures enable precise molecular recognition and dynamic conformational changes critical for sensing. Platforms such as logic gate-enabled microarrays, surface-enhanced Raman scattering nanoprobes, and polymeric DNA hydrogels provide high sensitivity and multiplexed detection of biomolecules including proteins, DNA, microRNAs, and epigenetic markers. Integration with nanomaterials like carbon nanotubes enhances in vivo sensing capabilities. Advances in CRISPR/Cas-based DNA nanobiosensors further improve specificity and rapid detection. Single-molecule studies elucidate DNA-lipid membrane interactions, facilitating membrane-integrated biosensors.

Conclusion: Programmable DNA nanostructures offer versatile, sensitive, and multiplexed platforms for next-generation biosensing and molecular diagnostics. Continued interdisciplinary efforts combining DNA nanotechnology with advanced nanomaterials and molecular tools are essential for clinical translation and developing precise diagnostic systems.

Keywords: *DNA nanostructures, Biosensing, Molecular diagnostics, DNA hydrogels, CRISPR biosensors, Surface-enhanced Raman scattering, Nanomaterials, Multiplexing, Molecular recognition.*

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Molecular Mechanisms of Vitamin E in the Reproductive System: A Comprehensive Review of Recent Evidence

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Background and Aim: Vitamin E, a potent lipid-soluble antioxidant, plays a critical role in maintaining reproductive health by protecting cellular membranes from oxidative stress. Both male and female fertility are influenced by oxidative damage, yet the molecular pathways through which vitamin E exerts its effects remain underexplored and fragmented across studies. This review aims to consolidate current findings on the molecular mechanisms of vitamin E in the reproductive system, identifying gaps and highlighting its therapeutic potential.
Method: Google Scholar, Web of Science, PubMed, and Scopus were used to perform a thorough literature search. Relevant studies were found using AI-assisted platforms such as Semantic Scholar and ScienceDirect Vitamin E, tocopherol, fertility, oxidative stress, reproductive system, and molecular pathways were among the search phrases used. English-language original and review papers that looked at the cellular or molecular effects of vitamin E on reproductive organs or functions and were published between 2020 and 2025 met the inclusion requirements.
Results: Clinical evidence is still limited in comparison to preclinical data, but recent studies show that vitamin E modulates reproductive function through multiple pathways, including suppression of lipid peroxidation, regulation of inflammatory cytokines, modulation of gene expression related to steroidogenesis and gametogenesis, and enhancement of mitochondrial function. It supports folliculogenesis, oocyte quality, and endometrial receptivity in females and improves spermatogenesis and sperm motility in males.
Conclusion: Vitamin E demonstrates strong molecular effects on reproductive health, mostly through antioxidative and gene-regulatory pathways. Further mechanistic and clinical research are necessary to establish its significance as a supplementary drug in reproductive therapy.
Keywords: *Vitamin E, Reproductive system, Oxidative stress, Fertility, Molecular mechanisms*

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Development of Hyaluronic Acid-Based Skin Patch Containing Nanocellulose for Wound Healing Applications

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Background and Aim: Effective wound management requires dressings that accelerate tissue repair, maintain moisture, and prevent infection. Conventional dressings such as gauze and cotton often fail to provide adequate healing conditions. This study aimed to design and evaluate a novel skin patch composed of bacterial nanocellulose incorporated with hyaluronic acid (HA) for improved wound healing outcomes.

Methods: Bacterial nanocellulose was synthesized using Stobachther xylinium cultures, purified, and combined with hyaluronic acid. The patch was characterized through structural and cytotoxicity assays. Cell viability was assessed using NIH3T3 fibroblasts via MTT assay. Antibacterial activity was evaluated against pathogenic bacterial strains. An in vivo wound healing model was conducted on male rats, comparing treated and control groups over a 7-day period.

Results: The MTT assay confirmed biocompatibility of the patch, with fibroblast cell viability above 90% at concentrations ≤0.1 mg/ml. Antibacterial tests revealed an inhibition zone of approximately 14 mm for the nanocellulose–HA patch compared to 11 mm in the control. In vivo evaluation showed a significant reduction in wound diameter: from 1.5 cm at baseline to 0.4 cm by day 7 in the treated group, versus 1.0 cm in controls.

Conclusion: The developed nanocellulose–hyaluronic acid skin patch demonstrated excellent biocompatibility, antibacterial activity, and enhanced wound healing in vivo. These findings suggest its strong potential as an advanced wound dressing for clinical applications.

Keywords: *Wound healing, Skin patch, Bacterial nanocellulose, Hyaluronic acid, Antibacterial activity*

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Vaccination and Treatment Strategies for Shingles: An Updated Review

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Background and Aim: Shingles (herpes zoster) is a viral infection caused by the reactivation of the varicella-zoster virus (VZV), the same virus responsible for chickenpox. It primarily affects individuals over 50 years of age and those with weakened immune systems. The disease is characterized by painful skin lesions, which may lead to postherpetic neuralgia (PHN), a persistent and debilitating nerve pain. This review aims to summarize current knowledge on the etiology, clinical presentation, prevention, and treatment of shingles, with a focus on the role of vaccination and antiviral therapy.

Methods: Relevant literature on shingles pathophysiology, clinical features, and management was reviewed, including published studies on antiviral treatments and vaccination efficacy.

Results: Shingles presents with pain, tingling, fever, headache, fatigue, and localized vesicular rashes. Early administration of antiviral medications such as acyclovir, as well as herbal antiviral ointments (e.g., Mirtoplex, Aftoplex, Melissane), can reduce the duration and severity of symptoms. Analgesics such as paracetamol, NSAIDs, or opioids are recommended for acute pain control. Vaccination with available shingles vaccines decreases the risk of developing the disease by 50–90% and reduces the likelihood and intensity of postherpetic neuralgia.

Conclusion: Shingles remains a significant public health issue, particularly in older and immunocompromised populations. Early antiviral treatment and pain management are essential to reduce complications, while vaccination is the most effective preventive strategy. Increased awareness and timely immunization can substantially lower the burden of shingles and its long-term sequelae.

Keywords: *Shingles, Herpes zoster, Varicella-zoster virus, Vaccination, Antiviral therapy*

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ABSTARCTS

Pear Skin Valorization Through Incorporation into Chocolate: A Useful Method to Increase Vitamins Content and Antioxidant Capacity

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Pear coproducts, which are the leftover skins, seeds, and pulp after the vinification process, are high in dietary fiber and can preserve up to 70% of the fruit's original phenolic components. Thus, reusing this residue as a food ingredient could simultaneously reduce environmental burdens, lower winery waste-management expenses, and improve the nutritional profile of fortified foods because it is produced in large quantities worldwide and its disposal is both expensive and technologically challenging. Accordingly, this study examined the nutritional enrichment of white chocolate by adding flour made from the fruit under study at three different weight-to-weight ratios: 0, 15, 30, and 45%. Following their production under industrial tempering circumstances, the developed chocolates and controls were examined for protein, lipids, sugars, dietary fiber, total phenolic content, antioxidant capacity (DPPH test), color, texture, and consumer perception (hedonic test). In comparison to the control, all fortified samples exhibited increased levels of fiber and antioxidant activity, specifically, chocolate made with 45% of coproducts pear flour had a higher Vitamin E content (07.38 mg/100g)) and DPPH (7985 µmol TE/100 g). A comprehensive organoleptic analysis, based on a tasting test, showed that all chocolate samples were well received by the tasters. All fortified chocolates showed texture weakening, regardless of the type degree of inclusion. Pear coproduct flour can be effectively promoted as a beneficial ingredient in prepared chocolates, advancing the circular economy concepts in the confectionery sector and creating products with enhanced nutritional and antioxidant properties.

Keywords: *Antioxidant activity, Pear coproducts, Dietary fiber, Functional foods, Product valorization, Chocolate*

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Effects of Maternal Protein Level during Early Gestation on Reproductive Performance in Multiparous Sows

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Background and Aim: Early pregnancy is a critical period for embryo implantation and rapid placental development. Dietary protein plays a key role in sow reproductive efficiency. This study aimed to evaluate the effects of different dietary protein levels during early pregnancy on reproductive performance, oxidative stress, and placental nutrient transport in multiparous sows.
Methods: A total of 45 multiparous Landrace × Large White sows were randomly assigned to three groups. From day 0 to day 30 of gestation, the sows were fed 2.5kg/d diets containing 12% (low protein, LP), 13.5% (medium protein, MP), or 15% (high protein, HP) crude protein. After that, all sows were fed the same gestation diet. Blood samples were collected from sows at day 30 of gestation (GD 30), and placentas were collected at farrowing. Total litter size, number of live piglets, and number of mummified fetuses were recorded.
Results: The results showed no significant effect on total litter size, number of live piglets, number of mummified fetuses or survival rate. And there has no effect on serum hormone level. However, sows in HP group exhibited certain hepatic stress and increased oxidative stress on GD 30. Serum amino acid profiling revealed higher levels of valine, isoleucine, leucine, tryptophan, and phenylalanine in HP group. Moreover, maternal protein intake during early pregnancy did not affect placental nutrient transport function.
Conclusion: In summary, maternal protein level of 12%-15% in early gestation didn't affect the reproductive performance in multiparous sows. However, higher protein intake during early pregnancy may disturb maternal metabolism and redox balance on GD 30, whereas lower protein levels observed better maternal metabolic health and oxidative homeostasis.
Keywords: *Maternal protein, Early pregnancy, Reproductive Performance, Oxidative stress, Nutrient transport, Sow*

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Upcycling Spent Coffee Grounds to Enhance Quality and Prolong Shelf Life of Refrigerated Beef

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Background and Aim: Spent coffee grounds (SCG) leading to huge generation have caused enormous environmental concern. Nevertheless, SCG are a complex mix of bioactive compounds which are slowly being explored for their efficiency in agri-food applications. In the present study the possibility of using aqueous SCG extract (SCGE) as a natural source of antioxidants for meat preservation has been tested.
Methods: Phytochemical contents (Total polyphenol and flavonoid content), antioxidant and antimicrobial activities (against *E. coli* and *Listeria monocytogens*) of the extract were determined. SCGE was added at 0.125% (SCGE1), 0.25% (SCGE2), and 0.5% (SCGE3) of the formula rate, then compared with 0.1% butylated hydroxytoluene (BHT). Their effects on the chemical stability, microbiological quality, instrumental color, and sensory attributes of beef were monitored over 14 days of refrigerated storage.
Results: In this study, the results showed that SCGE significantly ($p < 0.05$) delayed the formation of thiobarbituric acid reactive substances and carbonyls and reduced the sulfhydryl loss in a dose-dependent manner, indicating that SCGE had a protective effect against lipids and protein oxidation. A concurrent increase in redness and yellowness, along with a decrease in lightness, was observed. Thus, SCGE resulted in a reduced effect of chemical oxidation, microbial growth, and an improved of instrumental color and sensory traits.
Conclusion: This investigation proved that SCGE could be used as a sustainable natural preservative for novel applications in the agri-food sector
Keywords: *Spent coffee grounds, phenolic contents, Bioactivities, minced beef meat*

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Spent Coffee Grounds as a Support for Sustainable Biofertilizers

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Background and Aim: Coffee production and processing generate significant volumes of waste, particularly spent coffee grounds (SCG). Their recovery is part of a circular bioeconomy approach. This work explores the use of SCG as a matrix for the immobilization of a bacterial amylase for use in fertilization.
Methods: Amylase from Bacillus strain sp and spent coffee grounds (SPG) were used to prepare the fertilizer agent. Three different plant species (broad bean: Vicia faba, lentil: Lens culinaris, chickpea: Cicer arietinum) were used for the tracking of the root growth of plants basing on the number of survival stems, the number of leaves per stem, and the avearage length of stems.
Results: The immobilization of α-amylase from *Bacillus sp* on spent coffee grounds was evolved. After the optimization process, the immobilization efficiency was increased 5 times thanks to the optimized condition including an immobilization pH and temperature of ≈ 7.5 and 4°C, reaction time of 10 minutes, contact time of 45 minutes, and agitation speeds of 50 rpm. The immobilized enzyme exhibited a significantly greater fertilizing effect than coffee grounds used on their own. Indeed, depending on the species tested, the growth rate was increased by a factor ranging from 1.5 to 2.5. In addition, the immobilized enzyme's storage capacity was tried to compare to the free enzyme. After 25 days of storage at 25°C, the immobilized enzyme retained 70% of its activity, whereas the free enzyme dropped its activity inside of 3 days.
Conclusion: This study highlights the potential of SCG as an eff ective and sustainable matrix for enzyme immobilization, offering a dual benefit of waste valorisation and enhanced agricultural productivity.
Keywords: *Spent coffee grounds, Adsorption, Amylase, Biofertilizer*

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Toxicological and Pathophysiological Effects of a Pesticide: Protective Role of the Medicinal Plant *Cynara cardunculus*

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Background and Aim: This study investigated the hepatoprotective effect of *Cynara cardunculus* microspheres, a medicinal plant with well-established bioactive properties, against deltamethrin-induced toxicity in ex vivo hepatic fluids, liver tissues from Swiss mice. C. cardunculus is particularly noteworthy for its high phenolic content, which underlies its strong antioxidant and free radical–scavenging activities. It also demonstrates the ability to chelate iron- and hydrogen peroxide–derived radicals, along with inhibitory effects on pancreatic lipase.
Methods: Liver tissue extracts were prepared by homogenizing the recovered livers at 4 °C in 2 mL of Tris-buffered saline (TBS) using an Ultra-Turrax homogenizer, followed by centrifugation at 9000 rpm for 20 min at 4 °C. The resulting supernatants were aliquoted and stored at −80 °C for subsequent biochemical assays, including total protein quantification, TBARS (MDA) levels, superoxide dismutase (SOD) activity, catalase activity, glutathione peroxidase (GPx) activity, and reduced glutathione (GSH) levels.
Results: Exposure of hepatic tissues to deltamethrin for one hour led to pronounced lipid peroxidation and significant increases in antioxidant defense markers (SOD, CAT, GPx, and GSH) in both hepatic fluids and tissues. Substantial increases in hepatic biomarkers (ALT, AST, LDH, and ALP) were detected in hepatic fluids, confirming liver dysfunction. Co-treatment with C. cardunculus significantly alleviated these biochemical alterations, reduced oxidative stress, and restored antioxidant homeostasis, thereby limiting lipid peroxidation and enzyme leakage. These biochemical findings were supported by histopathological analyses, which demonstrated preserved hepatic architecture.
Conclusion: Collectively, these results highlight the hepatoprotective potential of *Cynara cardunculus* and support its role as a natural source of bioactive compounds with demonstrated protective effects, including the ability to counteract pesticide-induced hepatotoxicity

Keywords: *Cynara cardunculus, Deltamethrin, Hepatotoxicity, Oxidative stress, Antioxidants*

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Transforming Waste to Wealth: The Power of Recycling and Sustainable Waste Management in Fostering Economic Growth, Protecting Human Health, and Preserving the Environment

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Background and Aim: The world is at a critical juncture in managing its waste, with the potential to either exacerbate environmental degradation, health risks, and economic losses or harness waste as a valuable resource to foster sustainable development. This paper presents a comprehensive analysis of the transformative power of recycling and sustainable waste management in driving economic growth, protecting human health, and preserving the environment.

Methods: By leveraging cutting-edge technologies, innovative business models, and collaborative governance frameworks, waste can be converted into a wealth-creating asset, generating new revenue streams, creating jobs, and stimulating local economies. Our research reveals that effective recycling and waste management practices can reduce greenhouse gas emissions, conserve natural resources, and mitigate the environmental and health impacts of waste disposal. Furthermore, we identify successful case studies and best practices from around the world, demonstrating the potential for waste-to-wealth strategies to improve public health, promote sustainable consumption, and support the achievement of the United Nations' Sustainable Development Goals.

Results: The strategic harnessing of waste as a resource can empower cities and countries to generate new economic opportunities, stimulate technological innovation, and promote environmentally conscious consumption patterns, that aids humanity and the environment.

Conclusion: This paper provides a roadmap for policymakers, businesses, and civil society organizations to work together in transforming waste into a valuable resource, thereby creating a more circular, inclusive, and sustainable economy that benefits both people and the planet.

Keywords: *Recycling, sustainable waste management, economic growth, human health, environmental preservation, circular economy, sustainable development, waste-to-wealth.*

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Single and Combined Effects of Ceftazidime and Polystyrene Microplastics on Early Developmental Stages of Zebrafish

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Background and Aim: Aquatic ecosystems are increasingly contaminated with a mixture of emerging pollutants, including antibiotics and microplastics. Ceftazidime (CAZ), a β-lactam antibiotic widely used in human and veterinary medicine, frequently enters surface waters through wastewater discharge, where it may persist and exert ecotoxicological effects. One of the most common plastic pollutants, polystyrene microplastics (PS-MPs), among the most prevalent plastic pollutants, can interact with other contaminants, altering their bioavailability and toxicity. Zebrafish embryos and larvae (*Danio rerio*) are a sensitive vertebrate model for assessing the developmental and behavioral toxicity of contaminants at environmentally relevant concentrations.
Methods: Embryos were exposed to pollutants 5 hours post-fertilization (hpf) for 96 hours. After hatching, larval behavior was assessed using the DanioVision system. This study aimed to assess the individual and combined effects of 50 μg L^{-1} CAZ, and 1 mg L^{-1} PS-MPs on locomotor activity and anxiety-like behavior in zebrafish (*Danio rerio*) larvae using the light-dark test.
Results: Behavioral endpoints - including total distance moved, swimming velocity, and time or frequency spent in center and near the walls zones - were quantified following exposure. ANOVA method revealed group differences across both light and dark phases. The larvae exposed to CAZ or PS-MPs displayed reduced locomotor activity and increased thigmotaxis, indicative of an increased anxiety-like response. Combined exposure (CAZ + PS-MPs) further intensified these behavioral alterations, suggesting synergistic neurobehavioral toxicity.
Conclusion: These findings suggest that interactions between antibiotics and microplastics exacerbate stress-related behavioral alterations in zebrafish larvae, underscoring the potential ecological and neurotoxic risks associated with combined pollutant exposure in aquatic environments.
Keywords: *Ceftazidime, Polystyrene microplastics, Zebrafish larvae, Behavior*

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Effects of Foliar and Soil Cobalt Applications on Biofortification and Physiological Parameters in Tomato Plants

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Background and Aim: Cobalt (Co) is an essential element with important functions in human and animal health. Although cobalt is currently considered unnecessary for plant nutrition, its beneficial effects on plants have been identified. When cobalt is deficient in the soil, cobalt deficiency is observed in food products, leading to health problems. Cobalt biofortification in plants is among the most suitable options for increasing cobalt content in food products and supporting plant growth. However, in practice, dosage optimization issues arise depending on soil and plant conditions and application methods. This study aimed to determine the effects of soil and foliar cobalt applications on tomato plant growth, yield, cobalt biofortification and potential toxicity.

Methods: In the study conducted in a greenhouse cultivation environment, increasing doses of cobalt were applied to tomato plants via soil and foliar application. At harvest, the growth of tomato plants, fruit yield, cobalt content in leaves and fruit, total chlorophyll content, and total phenol content were analyzed.

Results: Leaf and soil cobalt applications increased plant height, fruit yield, cobalt content in leaves and fruits, and total chlorophyll content in tomato plants at low-to-medium application levels, while decreasing these parameters at high application levels. Total phenol content in the leaves and fruits of tomato plants increased in both applications. In foliar cobalt applications, the cobalt content of tomato leaves was found to be higher, while in soil cobalt applications, the cobalt content of tomato fruit was found to be higher.

Conclusion: The results showed that low-to-medium levels of cobalt application to soil and leaves successfully improved plant growth, yield, and cobalt biofortification. However, cobalt application via both methods significantly increased stress factors in plants, and a significant decrease in growth and yield was recorded at high cobalt application levels.

Keywords: *Biofortification, Cobalt, Soil and Foliar Application, Tomato*

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When Medicine Meets Microplastics: Dissecting the Environmental Toxicity of Ibuprofen and LDPE in Zebrafish Embryos

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Background and Aim: Pharmaceutical residues and microplastics are emerging contaminants in aquatic ecosystems. Ibuprofen (IBU), a widely used NSAID, and Low-density polyethylene (LDPE) microplastics (MPLs) are frequently found in surface waters. While their individual effects are documented, their combined impact during early development remains unclear.
Methods: Healthy AB strain zebrafish embryos were obtained via natural spawning and screened under a stereomicroscope. Morphologically normal embryos were selected at 5 hpf and exposed in 24-well plates to E3 medium containing ibuprofen (1 mg/L), LDPE microplastics (1 mg/L), or both. Exposure lasted until 96 hpf, with daily media renewal. Conditions followed OECD guidelines, including a 14:10 light-dark cycle. At 96 hpf, behavioral analysis was performed using EthoVision XT, followed by imaging and measurement of biometric endpoints such as total length and interocular distance.
Results: All the larvae exhibited increased activity during the dark phases, consistent with typical zebrafish behavior. However, the groups exposed to IBU alone and in combination with LDPE showed distinct behavioral alterations compared to the control and LDPE-only groups. Notably, larvae treated with IBU, and the mixture spent significantly more time near the edges of the wells, exhibited prolonged periods of immobility, and demonstrated increased swimming velocity. These behaviors suggest erratic movement and stress responses. Interestingly, LDPE MPLs alone did not induce significant behavioral deviations from the control group, suggesting relatively low acute toxicity under the tested conditions. The mixture did not mitigate the effects of IBU, indicating that the presence of plastic particles may neither buffer nor exacerbate the pharmaceutical's impact in this context.
Conclusion: These results highlight that not all pollutants have equally visible effects. Ibuprofen, even at low concentrations, showed significant developmental impact, while LDPE appeared less toxic under these conditions. Still, microplastics remain a concern due to their potential role in modifying chemical toxicity.
Keywords: *pharmaceuticals, microplastics, zebrafish*

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Agro-Ecological Interactions Between Pests and Beneficials in the Extreme North-East of Algeria

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Background and Aim: The ecological sustainability of agricultural landscapes depends on maintaining a dynamic balance between pest populations and their natural enemies. In north-eastern Algeria, particularly within and around the El Kala National Park, diverse habitats support both harmful and beneficial arthropods. This study provides a comprehensive synthesis of existing data on pest and auxiliary insect fauna in the region, with the aim of assessing their diversity, ecological interactions, and implications for sustainable pest management.

Methods: The analysis was based on institutional archives and technical reports provided by the El Kala National Park (PNEK), the Directorate of Agricultural Services (DSA), and the Forest Conservation Department, complemented by published studies conducted between 2015 and 2025. Taxonomic identification and functional classification focused on arthropods associated with major agroecosystems, including cereals, vegetable crops, and forest margins.

Results: The synthesis revealed a remarkable diversity of arthropods, comprising major pest taxa such as Spodoptera littoralis, Helicoverpa armigera, Sitophilus oryzae, and Bemisia tabaci, all of which cause significant economic losses. Conversely, a wide array of beneficial insects was documented, notably Coccinella septempunctata, Hippodamia variegata, Episyrphus balteatus, and hymenopteran parasitoids (Braconidae, Ichneumonidae). Their presence and abundance indicate that natural regulation processes remain active within these agroecosystems.

Conclusion: The coexistence of pest and beneficial arthropods highlights a still-functioning but increasingly fragile ecological equilibrium. Anthropogenic pressures—especially pesticide use and habitat simplification—threaten this balance. Strengthening biological control through Integrated Pest Management (IPM), habitat diversification, and ecological infrastructure (e.g., flower strips, hedgerows) appears essential to preserve biodiversity and ensure sustainable crop protection. This synthesis constitutes the first regional overview of pest–auxiliary interactions in north-eastern Algeria and provides a scientific basis for future agroecological policies.

Keywords: *Beneficial insects, crop pests, biodiversity, biological control, El Kala National Park, north-eastern Algeria*

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Effects of Lead (Pb) on Biomass and Chlorophyll of *Bruguiera sexangula* (Lour.) Poir. Seedlings

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Background and Aim: Mangrove ecosystems, vital for coastal protection and biodiversity, are increasingly threatened by lead pollution from urban and industrial activities. *Bruguiera sexangula*, a key species in the Sundarbans, is sensitive to Pb which can impair photosynthesis, nutrient uptake and growth. This study aimed to investigate the effects of Pb on the growth and chlorophyll content of *B. sexangula* seedlings to determine dose dependent toxicity.
Methods: Seven Pb concentrations (0, 5, 10, 20, 30, 40, and 50 mg/L) were applied to *B. sexangula* seedlings using $Pb(NO_3)_2$ in modified Hoagland's solution with salinity adjusted to 15 ppt. Propagules were collected from the Sundarbans, raised in nursery beds and transplanted into experimental pots with coarse sand. The experiment, conducted under semi-greenhouse conditions for 8 months, measured growth parameters like height increment and fresh biomass. Chlorophyll content was extracted and quantified using DMSO, and statistical analysis was performed using one-way ANOVA and Duncan's Multiple Range Test.
Results: The results indicated that Pb exposure significantly reduced the height, collar diameter and biomass of *B. sexangula* seedlings, with the most pronounced effects observed at the highest concentrations (40 and 50 mg/L). The chlorophyll content of the seedlings also decreased significantly as Pb concentration increased, indicating impaired photosynthetic efficiency. Statistical analysis revealed highly significant differences ($p < 0.001$) in all growth parameters and chlorophyll content among the treatments with the control group (0 mg/L Pb) showing the highest growth and chlorophyll values.
Conclusion: Lead contamination significantly impairs B. sexangula seedling growth and chlorophyll content with concentrations above 20 mg/L causing substantial physiological damage. These results highlight the vulnerability of mangrove ecosystems to Pb pollution and underscore the need for effective monitoring and remediation strategies.
Keywords: *Bruguiera sexangula, Lead toxicity, Mangroves, Biomass, Chlorophyll*

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