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ORGANISATION DU MONDE ISLAMIQUE POUR L'EDUCATION, LES SCIENCES ET LA CULTURE

INTERNATIONAL CONFERENCE

ADVANCED MATERIALS FOR BIOMEDICAL AND ENVIRONMENTAL CHALLENGES

"AMBEC-2024"

Dedicated to 105th anniversary of Baku State University
2024-Green World Solidarity Year

ABSTRACT BOOK

DECEMBER 23-24, 2024
BAKU STATE UNIVERSITY
BAKU, AZERBAIJAN

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International Conference Advanced Materials for Biomedical and Environmental Challenges, "AMBEC-2024". December 23-24, 2024. Baku State University. Baku: BSU Publising House, 2025. – 122 p.

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Azərbaycan Respublikasında 2024-cü ilin “Yaşıl dünya naminə həmrəylik ili” elan edilməsi haqqında Azərbaycan Respublikası Prezidentinin SƏRƏNCAMI

Azərbaycan Respublikası beynəlxalq ictimaiyyətin etibarlı və məsuliyyətli üzvü kimi iqlim dəyişmələrinin fəsadlarına qarşı mübarizəyə öz töhfəsini verir.

Azərbaycanın 2030-cu ilə qədər sosial-iqtisadi inkişafa dair beş milli prioritetindən biri “Təmiz ətraf mühit və yaşıl artım ölkəsi” kimi müəyyən edilmişdir. Həmin prioritetə uyğun olaraq, ətraf mühitin sağlamlaşdırılması, yaşıllıqların bərpası və artırılması, su ehtiyatlarından və dayanıqlı enerji mənbələrindən səmərəli istifadənin təmin edilməsi istiqamətində işlər aparılır.

Azərbaycan baza ili (1990) ilə müqayisədə 2030-cu ilə qədər istilik effekti yaradan qazların emissiyalarının 35 faiz, 2050-ci ilə qədər isə 40 faiz azaldılmasını hədəf kimi götürmüşdür.

İşğaldan azad edilmiş Qarabağ və Şərqi Zəngəzur, eləcə də Naxçıvan Muxtar Respublikası yaşıl enerji zonası elan olunmuşdur. Azad edilmiş ərazilərdə həyata keçirilən genişmiqyaslı bərpa və yenidənqurma prosesində ətraf mühitin qorunması prioritetdir. Həmin ərazilərdə “ağıllı şəhər”, “ağıllı kənd” kimi innovativ yanaşmalar tətbiq edilir, ekosistem bərpa olunur.

Yaşıl enerji növlərinin yaradılması və yaşıl enerjinin dünya bazarlarına nəqli Azərbaycanın enerji siyasətinin prioritetidir. Azərbaycan elektrik enerjisi istehsalının qoyuluş gücündə bərpa olunan enerji mənbələrinin payının 2030-cu ilə qədər 30 faizə çatdırılmasını hədəfləyir.

BMT-nin İqlim Dəyişmələri üzrə Çərçivə Konvensiyasının Tərəflər Konfransının 29-cu sessiyası – COP29 kimi mötəbər bir tədbirin Azərbaycanda keçirilməsi ilə əlaqədar yekdil qərarın verilməsi beynəlxalq ictimaiyyət tərəfindən Azərbaycana böyük hörmət və etimadın, eləcə də ölkəmizin milli, regional və qlobal səviyyədə ətraf mühitin qorunması, iqlim dəyişmələrinin qarşısının alınması işinə töhfəsinin təqdir olunmasının bariz nümunəsidir.

Azərbaycan Respublikası Konstitusiyasının 109-cu maddəsinin 32-ci bəndini rəhbər tutaraq, iqlim dəyişmələrinə qarşı qlobal mübarizədə beynəlxalq həmrəyliyin gücləndirilməsi məqsədilə qərara alıram:

1. Azərbaycan Respublikasında 2024-cü il “Yaşıl dünya naminə həmrəylik ili” elan edilsin.

2. Azərbaycan Respublikası Prezidentinin Administrasiyası Azərbaycan Respublikasında 2024-cü ilin “Yaşıl dünya naminə həmrəylik ili” elan edilməsi ilə bağlı tədbirlər planına dair təkliflərini bir ay müddətində hazırlayıb Azərbaycan Respublikasının Prezidentinə təqdim etsin.

İlham Əliyev
Azərbaycan Respublikasının Prezidenti

Bakı şəhəri,
25 dekabr 2023-cü il

FOREWORD

Dear Colleagues and Participants,

It is with great pleasure that we welcome you to the International Conference "AMBEC-2024: Advanced Materials for Biomedical and Environmental Challenges", held at Baku State University, Azerbaijan, on December 23–24, 2024. This event dedicated to the 105th anniversary of Baku State University & 2024-Green World Solidarity Year Green, brings together scientists, researchers, and experts from diverse disciplines to address some of the most pressing challenges of our time.

AMBEC-2024 is a testament to the growing importance of interdisciplinary collaboration in tackling complex issues at the intersection of material sciences, biomedicine, and environmental sustainability. The conference serves as a platform to showcase pioneering research, foster dialogue, and explore innovative solutions that contribute to the global agenda for a sustainable and resilient future.

The program is thoughtfully designed to encompass a wide range of topics, from the synthesis of advanced bioactive compounds and green-oriented research to the development of supramolecular materials and nano ensembles. Special emphasis is placed on ethnobotany, ethnopharmacology, and materials for environmental security—fields that hold tremendous potential for addressing global health and ecological challenges.

Beyond the scientific presentations, AMBEC-2024 aims to inspire young researchers, encourage knowledge sharing, and establish enduring partnerships among academia, industry, and international organizations. We are confident that the discussions and collaborations initiated here will lay the foundation for impactful research and practical applications that advance the Sustainable Development Goals.

We extend our heartfelt gratitude to all participants, speakers, and contributors for their valuable involvement in making this conference a success. A special thanks to our organizing team and sponsors, whose dedication and support have been instrumental in bringing this event to fruition.

We look forward to an engaging and productive exchange of ideas and wish you all a memorable and enriching experience at AMBEC-2024.

Warm regards,

Elchin Babayev
Rector of Baku State University, Azerbaijan

Raheel Qamar
Head of Science and Technology Sector, ICESCO

ABOUT

Advanced Materials for Biomedical and Environmental Challenges (AMBEC–2024) is devoted to the discussion of crowning scientific achievements in recent years adopted in the fields of materials sciences with biomedical and environmental applications. It also aims to discuss the experimental and theoretical achievement, identify the applicable areas of the most recent innovations, exchange, and share experiences with leading academic scientists, and stimulate the scientific motivation of young researchers. AMBEC–2024 will present and cover the most recent innovations, trends, and concerns in the interdisciplinary fields of biology, chemistry, ecology and material science.

Apart from plenary and invited lectures, the international conference will include sessions with oral and poster presentations by junior and senior researchers. Among the main goals of this event is to establish new research partnerships with national and international organizations to identify specific research areas. In essence, the conference will help lay the groundwork for a sustainable future to optimize education and research.

All materials of international conference are made available through the AMBEC Website (http://www.ambec2024.bsu.edu.az/).

The AMBEC-2024 conference will contribute to:

- Networking and communication between scientists of ICESCO states and neighbouring countries in terms of regional and international cooperation projects with a focus on industry needs, research, and education communities.
- A significant contribution to strengthening the research and innovation potential of ICESCO states and neighbouring countries in the field of advanced materials for biomedical and environmental purposes.
- Consolidated collaboration between academic research groups and representatives of the industrial sector and facilitate opportunities to reposition and/or extend the economic life of patented drugs, as well as create additional revenue streams, thereby significantly influencing the commercialization of newly synthesized compounds.
- Develop effective mechanisms to accelerate joint scientific projects, green technologies, and the involvement of the younger generation of scientists - students and PhDs for introducing fresh and revolutionary ideas.

TOWARDS THE DEVELOPMENT OF FURAN-BASED DERIVATIVES AS A NEW CLASS OF SALICYLATE SYNTHASE (MBTI) INHIBITORS WITH ANTIMYCOBACTERIAL ACTIVITY

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Despite global efforts to develop innovative therapeutic approaches, tuberculosis remains one of the leading causes of mortality from a single infectious agent. Several pathogenic strains of *Mycobacterium tuberculosis* (Mtb) have developed resistance to most established antitubercular drugs, highlighting the urgent need for new therapeutic options.

We focused our attention on a target essential for the survival of Mtb during infection: salicylate synthase I (MbtI), an enzyme absent in human cells that catalyzes the first step in the biosynthesis of iron-chelating siderophores.

In our ongoing research, we have identified highly effective MbtI inhibitors. Supported by the co-crystal structure of MbtI in complex with 5-(3-cyanophenyl)furan-2-carboxylic acid, we defined the structural requirements necessary for both efficient MbtI inhibition and potent antitubercular activity. Subsequently, we targeted the immune system to investigate how nanoparticles can be used to selectively deliver our inhibitors to infected macrophages.

The selected carriers were poly(2-(methacryloyloxy)ethyl phosphorylcholine)-poly(2-(diisopropylamino)ethyl methacrylate) polymersomes. These systems specifically target infected phagocytes through phenotypic association with scavenger receptors and efficiently deliver their cargo into the cytosol, where most bacilli reside.

NOVEL CHALCONE SYNTHESIS USING SALICYLALDEHYDE DERIVATIVE AND PENTANE-2,4-DIONE

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Chalcone is a unique template that is associated with several biological activities. It has a broad designation for substances with the 1,3-diphenylprop-2-en-1-one (1) framework. In fact, few structural templates have been linked to such a broad spectrum of pharmacological actions, including cytotoxicity, anticancer, anti-inflammatory, anti-plasmodial, immunosuppressive, and antioxidant effects. These characteristics make chalcones an essential building block in the field of medicine, for producing medicinal products and the synthesis of bioactive heterocyclic molecules. Their basic simplicity and strong reactivity enable major chemical alterations that enhance biological effectiveness, making them a vital tool in drug discovery and design.

Chalcones are primarily synthesized by the Claisen-Schmidt condensation, a classical chemical reaction that involves the aldol condensation of an aromatic aldehyde and a ketone. This reaction is commonly conducted in basic or acidic conditions, followed by dehydration to produce the chalcone framework. The choice of catalyst, solvent, temperature, and reaction time all have a substantial impact on the final product's yield and purity, allowing for fine-tuning and optimization.

Chalcones have been intensively researched not only for their therapeutic properties but also for their applications in material sciences and other chemical industries. Their various pharmaceutical applications have prompted research into their mechanisms of action and structure-activity correlations.

By focusing on literature, a novel chalcone was obtained from the Claisen-Schmidt condensation reaction of pentane-2,4-dione and 2-hydroxy-5-nitro-salisylaldehyde. The structure of the produced chalcone was studied using 1H, 13C, and DEPT NMR spectroscopic techniques. The biological activities of this novel chemical were tested against several bacteria.

NOVEL THERAPY APPROACHES TO COMBAT EMERGING MULTIDRUG-RESISTANT PATHOGENS

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Multidrug-resistant (MDR) pathogens pose a significant threat to global public health due to their resistance to conventional antibiotics and their association with high morbidity and mortality. In addition to MDR strains, the emergence of hypervirulent clones has become a critical concern due to their ability to cause invasive infections. These hypervirulent strains often harbor genetic determinants that enhance their pathogenicity. Antivirulent therapies have emerged as promising alternatives to traditional antibiotic approaches, targeting the mechanisms of pathogenesis rather than bacterial viability. This strategy aims to disarm pathogens by inhibiting virulence factors, such as attachment, quorum sensing, biofilm formation, and secretion systems. This reduces the likelihood of resistance development and minimizes disruption to the host microbiota. For instance, mannose-binding fimbriae of Escherichia coli is crucial for host adhesion and colonization. The peg-344 gene in Klebsiella pneumoniae is responsible for metabolic adaptability. The outer membrane protein W (ompW) contributes to host adhesion and immune evasion. Targeting these virulence factors can block the infection process. On the other hand, the effectiveness of these strategies may differ by strain type and host immune responses. By targeting MDR Gram-negative infections and hypervirulent pathogens, antivirulent strategies provide a promising paradigm shift for mitigating the global threat of antibiotic resistance.

This presentation will explore the current advancements in antivirulent therapies, detailing their mechanisms of action and addressing key challenges in their clinical translation. These challenges include ensuring specificity, optimizing delivery systems, and evaluating the long-term potential for resistance.

ADVANCING ARTIFICIAL HEART VALVES: POLYURETHANE NANOCOMPOSITE MEMBRANES MODIFIED WITH GRAPHENE OXIDE AND PHENOLIC ACIDS

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Advancing materials for artificial heart valves (HVs) is a critical endeavor in cardiovascular medicine, addressing challenges such as durability, biocompatibility, and tissue regeneration. This study focuses on the synthesis and characterization of polyurethane (PU) nanocomposite membranes modified with graphene oxide (GO) and lignin nanoparticles to create a robust, biocompatible material for HV applications.

Polymeric heart valves (PHVs) are emerging as a promising alternative to traditional mechanical and bioprosthetic valves, overcoming issues like thrombogenicity, anticoagulation requirements, and limited durability. PU, a widely studied elastomer for biomedical applications, offers unique mechanical properties and hemocompatibility. However, challenges such as calcification and biodegradation necessitate further modification. Here, PU membranes are functionalized with GO, lignin units (LUs), and copper ions to enhance their structural and biological performance.

GO was synthesized using a modified Hummers method and covalent functionalization with LUs to integrate antioxidant and regenerative capabilities. The incorporation of copper ions was achieved through chelation, leveraging their antithrombogenic and antimicrobial properties. These composite materials were fabricated into nanofiber membranes using electrospinning (ES), optimizing parameters such as voltage, flow rate, and distance to produce uniform, functionalized fibers. Morphological, chemical, and mechanical properties of the membranes were characterized using advanced techniques like TEM, FTIR, and mechanical testing, demonstrating significant improvements in tensile strength, elasticity, and durability.

The biological evaluations highlighted the membranes' enhanced hemocompatibility, reduced platelet adhesion, and promising regenerative effects, attributed to the synergistic effects of GO, LUs, and copper ions. The membranes also exhibited superior resistance to oxidative degradation, ensuring prolonged functionality under physiological conditions.

This work presents a novel approach to advancing artificial HV technology, showcasing the potential of PU nanocomposites to address current limitations in cardiovascular implants. By integrating state-of-the-art nanotechnology with biomedical material science, this study paves the way for the development of artificial heart valves that combine life-long durability with regenerative capabilities, ultimately improving patient outcomes and quality of life.

THE STORY OF NEW HDAC1-3 INHIBITORS IN GASTRIC CANCER TREATMENT, FROM DREAM TO REALITY: 360 MOLECULES, ONE TARGET

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In the world health organization (WHO) reports, gastric cancer (GC) ranks is fifth in the world and third in Turkey among the causes of death. For epigenetic treatment, enzyme inhibitors such as histone deacetylase inhibitors (HDAC1, HDAC2, are HDAC3) are used. When reviewed as a concept, epigenetics is a subdiscipline of biology examining changes in gene expression, which do not result from changes in DNA but are hereditary. Recently, new treatment strategies focusing on gene mutations have concentrated on epigenetic changes. One of the most common types of epigenetic changes includes histone modifications. Contrary to genetic changes, epigenetic changes can be reversed. Therefore, epigenetic change has become an alternative method in the treatment of many types of cancer. One of the targets for epigenetic therapy is HDAC enzymes. This study will focus particularly on HDAC enzyme inhibitors used especially in the treatment of GC. HDAC inhibitors are divided into three main groups: surface recognition group (CAP), binding domain, and zinc-binding group (ZBG). Changes are observed in the binders and ZBG in the development of HDAC enzyme inhibitors. Benzamide compounds are in the class of significant HDAC inhibitors.

In this study, 60 ZBG group changes were designed with 6 binders. A total of 360 benzamide compounds designed theoretically will be examined as computational chemistry and in silico techniques. The whole molecules were optimized at B3LYP-D3/6-31G level in water. Then, molecular docking, ADME, MM-GBSA, MM-PBSA and p450-cytochrome analyses were performed in detail.

As a result, molecular docking analyses of 360 newly designed multifunctional benzamide compounds were optimized by computational chemistry methods and molecular docking analyses were performed. As a result of the calculations obtained, it was decided to perform subsequent analyses of 67 molecules. As a result

of ADME and p450 calculations, the number of molecules to be synthesized decreased to 36. It was decided to synthesize 36 molecules because it was predicted that their interactions would be good as a result of MM-GBSA and MM-PBSA calculations.

Acknowledgement: We would like to thank The Scientific and Technological Research Council of Türkiye (TÜBİTAK) for the financial support under the project number 121Z529.

SYNTHESIS OF PROTECTED AMIDE TOWARDS C(O)-N BOND CLEAVAGE UNDER CATALYST-FREE CONDITION

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Today, organic synthesis has reached a remarkable level of competence and even the most complex molecules are accessible. The prerequisites for this success are both the availability of a wide range of efficient synthetic methods and reagents, and the fact that "retrosynthetic analysis" can provide a framework for the design of a synthetic strategy leading to the desired product in the most efficient and logical way. The complex synthetic intermediates and products contain, in general, a multiplicity of functional groups, most of which must be blocked and, at an appropriate point in the synthesis, liberated. The choice of protecting groups is one of the decisive factors in the successful realization of a complex, demanding synthetic project. The protecting groups used influence the length and efficiency of the synthesis and are often responsible for its success or failure. A wide range of blocking groups are currently available for the different functional groups.

In the past two years, tremendous progress has been reported in the development of new methods for the cross-coupling of amides by N−C bond activation. Typically, amides have long been considered unreactive for the powerful metal and Grignard reagents insertion into the acyl N−C(O)amide bond due to amidic resonance. While a range of methods to activate the amide bond toward selective metal and Grignard reagents insertion has been developed, by far the most synthetically useful are N-Boc and N,N-di-Boc-activated amides allowing direct engagement with common primary and secondary amides in a range of cross-coupling methods after double N-tert-butoxycarbonylation under mild conditions.

All in all, we synthesized protected amide molecule (di-tert-butyl ((butane-1,4-diylbis(oxy))bis(propane-3,1-diyl))bis((4-nitrobenzoyl)carbamate)) by N-tert-butoxycarbonyl for transforming into ketones under catalyst-free conditions. N-Boc benzamide was synthesized following a standard procedure from the literature. The reaction was conducted under argon atmosphere at room temperature. The crude product was purified using silica gel column chromatography (SiO2: ethyl acetate/hexane) to isolate the desired N-Boc benzamide on both side of the amide molecule.

Acknowledgement: This work was supported by the Azerbaijan Science Foundation-Grant No AEF-MCG-2023-1(43)-13/09/3-M-09

COMPREHENSIVE ANALYSIS OF STRUCTURAL PROPERTIES AND *IN VITRO* BIOACTIVE PERFORMANCE IN TITANIUM-DOPED 45S5 BIOGLASSES

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Bioactive glass is extensively used in tissue engineering due to its excellent bioactivity, biodegradability, and osteoconductivity. Recent modifications to traditional bioglass compositions by adding various elements have gained attention in

biomaterials research. Titanium (Ti) doped bioglasses have gained significant interest due to the advantageous properties of Ti.

The primary objective of this study was to investigate the properties of novel 45S5 bioactive glasses doped with varying TiO_2 concentrations (0.5-4%). Hence, this study employed comprehensive analytical techniques including Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FT-IR), and Vickers hardness testing to characterize and evaluate the material's structural and mechanical characteristics. *In vitro* bioactivity was assessed via immersion tests in simulated body fluid (SBF) for up to four weeks, monitoring the biological medium's composition through ICP-OES analyses. Both FTIR and SEM analyses were performed before and after immersion tests. The hydrolytic degradation behavior of the samples was tracked by measuring pH changes in a tris-(hydroxymethyl)-aminomethane (TRIS) solution. Biocompatibility was evaluated through *in vitro* cell culture tests (MTT assay for SAOS-2 cells).

Consequently, SEM and FT-IR results confirmed the formation of carbonated hydroxyapatite on the bioglasses. Vickers hardness increased with higher TiO_2 content, while TRIS pH rose slightly with longer immersion times. *In vitro* tests demonstrated that TiO_2 incorporation enhances differentiation and promotes bone growth. The high bioactivity and biocompatibility of TiO_2-doped bioglasses suggest their potential as alternatives to conventional glasses in bone regeneration applications.

Acknowledgement: The authors express their sincere appreciation to TUBITAK (The Scientific and Technological Research Council of Turkey) for providing financial assistance through the 3001-research project, Grant No: 21M647.

CALCIUM CARBONATE AND HYDROXIDE NANOPARTICLES FOR CEMENT REINFORCEMENT

[1,2,*]Hasanova I., [3]Hasanova U., [4]Gasimov E., [4]Rzayev F., [5]Hajiyev E., [6]Eyvazova G., [7]Shaliyev M., [7]Mehdiyeva A., [8]Aliyeva N., [8]Yusifov Y., [9]Ismayilov H., [1,3]Akhundzada H. V., [6]Aghamaliyev Z., [1]Hajiyeva S., [10]Huseynova P.

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Cement is main construction material and achieving full control on development of its compressive strength is very important tool for construction industry. Applying inorganic nanoparticles as additives to cement is a promising strategy because they can accelerate hydration by acting as crystallization centres and fill nanopores and cracks which emerge at nano dimension. Our research group developed precipitation methodology for synthesizing calcium hydroxide and calcium carbonate nanoparticles. Since morphology and sizes of nanoparticle additives affect mechanical properties of cement we investigated how they could be tuned under different synthesis conditions. It was revealed that isotropic calcium carbonate nanoparticles enhance compressive strength of 2-day cement by 30 % while flexural strength of 2-day cement is increased by 50 %. The optimal results were obtained with 0.06% $CaCO_3$ nanoparticles, which boosted the flexural and compressive strength of 28-day cement by approximately 12% and 9%, accordingly. Additionally, the compressive strength of all samples containing calcium hydroxide nanoparticles increased by more than 20% at 2 days and over 5% at 28 days, while the flexural strength of all 2-day cements rose by more than 25%.

THE FLOWER POWER OF BULGARIAN ROSES – DELICATE PERFUME AND NATURAL MEDICINE

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We investigated the biological activities of the products of the steam distillation of the four types of Bulgarian oil-bearing roses - Rosa damascena Mill., Rosa alba L., Rosa gallica L., and Rosa centifolia L. The results obtained from our research are in service of the needs of the circular economy, waste-free technologies, and absorption of the benefits of all stages of rose processing in Bulgaria. In this sense,

our team created a platform for absorption with information about the valuable biomedical qualities of all products of this production and answers to environmental challenges.

The search for new therapeutic alternatives directs us to investigate the effects of essential oils on the viral reproduction of susceptible (Victoria) and acyclovir-resistant (R-100) strains of HSV-1 replication in vitro, individually, and in combination with acyclovir. Essential oils can influence only viral adsorption, and extracellular virions and protect healthy cells from subsequent infection.

The wastewater from the distillation of rose oils is discharged directly into the soil because it has a limited potential for future applications. We determined in vitro the chromatographic profile, redox-modulating capacity, and antineoplastic activity of wastewater obtained after distillation of essential oils from Bulgarian roses. They have a good redox-modulating capacity and exhibit the properties of excellent heavy metal cleaners, with low cytotoxic effects.

We evaluated the possibility of cytotoxic/genotoxic activity changes in essential oils, hydrosols, and wastewater. All tested products from the steam distillation of Bulgarian oil-bearing roses showed an excellent toxicological safety profile depending on the amounts of polyphenols contained in them.

SYNTHESIS OF NOVEL VITAMIN B6-BASED AZOMETHINES

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Among the most important synthons in organic chemistry are Schiff bases, also known as azomethines. These compounds are highly appealing to chemists due to their broad biological and synthetic applications. Studies have shown that Schiff bases possess unique properties, including antibacterial, antiviral, antifungal, anti-HIV, antidiabetic, and anticancer activities.

Pyridine derivatives exhibit a wide range of notable biological activities and are extensively used in clinical settings. These compounds serve as antioxidants, antivirals, antimicrobials, antidiabetics, antimalarials, antitubercular agents, psychopharmacological antagonists, antiproliferatives, and anti-inflammatory agents.

Their biological significance is largely attributed to their water solubility, chemical stability, hydrogen bonding ability, and small molecular size.

Natural chemicals containing a pyridine ring include niacin, vitamin B6, nicotinamide adenine dinucleotide, and trigonelline. Additionally, pyridoxal, a form of vitamin B6, is vital for metabolic processes like deamination, transamination, and decarboxylation, as well as the metabolism of amino acids, sugars, and fats.

Considering everything mentioned, novel azomethines were synthesised based on vitamin B6 and aliphatic polyamine. The aldehyde component was pyridoxal hydrochloride and the amine triethylenetetramine. The structures of the novel Schiff bases were verified using 1H and 13C NMR, mass spectroscopy, and elemental analysis.

Acknowledgement: This work was supported by the Science Development Foundation under the President of the Republic of Azerbaijan – Grant № AEF-GAT-7-2023-2(44)-10/08/4-M-08.

IMPACT OF MULTI-DISCIPLINARY STUDY MODEL ON INFECTIOUS DISEASES

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Increasing multidrug resistance of bacteria critically limits the effective antibiotic therapy and has become an apparent global health threat. The simulation studies show that until 2050, death rates from drug resistant infections will dramatically increase the mortality rates and exceed the cancer related deaths. Due to the current limitations of last resort antibiotics and the potent resistance of bacteria to new synthetic drugs, alternative infection treatment approaches are much of interest. Especially, the nanoparticle based targeted drug delivery designs and/or light activation of nanoparticles/photosensitizing agents/ quantum dots to cause ROS-mediated bacterial killing are some promising examples. We do focus on exploring the antibiotic resistance mechanisms in detailed molecular basis and is interested to design such alternative systems to avoid antibiotic limitation. For this purpose, the multi-disciplinary collaborations are very critical. In this conference "Advanced materials for biomedical and environmental challenges AMBEC-2024", we will be sharing some of our publications which antibacterial efficiency of such alternative approaches were analyzed. Following the brief introduction to

photodynamic/photothermal (PDT/PTT) ROS mediation for bacterial inhibition, detail on selective antibacterial activity of chlorinated hemicyanine molecule with PDT against gram-positive bacteria, ROS-mediated bacterial inhibition of InP/ZnO quantum dots, antibacterial PDT activity of ICG and our model of fimbria-targeting iron oxide nanoparticle-ciprofloxacin carrying design for ciprofloxacin-resistant *Escherichia coli* will be explained.

SYNTHESIS OF NOVEL SALEN-TYPE AZOMETHINES

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Salen and its derived ligands are highly valued for their ease of synthesis, versatile coordination with a wide range of metal ions, ability to adopt various spatial geometries, and capacity to stabilize metal ions in multiple oxidation states. These characteristics have made them exceptionally popular for diverse applications.

Ortho-vanillin Schiff bases are multifunctional ligands synthesized through the condensation of 2-hydroxy-3-methoxybenzaldehyde with amine compounds, offering the potential to create an extensive range of derivatives. These ligands are widely used in coordination chemistry because of their ability to form highly stable complexes with most metals. This stability is attributed to the nitrogen atom of the azomethine group, along with two oxygen atoms from the hydroxyl and methoxy groups.

Ortho-vanillin Schiff bases and their metal complexes are significant for their antibacterial, antifungal, antioxidant, and anticancer properties. Additionally, numerous pharmaceutical studies suggest their ability to interact with DNA, making them promising candidates for biomedical applications. These compounds are also being extensively explored for their potential in catalysis, polymer synthesis, dye production, and pharmaceutical development.

Considering everything mentioned, novel azomethine was synthesised based on salen and aliphatic polyamine. The aldehyde component was 5-bromo-o-vanillin and the amine triethylenetetramine. The structure of the novel Schiff base were verified using ^{1}H and ^{13}C NMR and mass spectroscopy.

Acknowledgement: This work was supported by the Science Development Foundation under the President of the Republic of Azerbaijan – Grant № AEF-GAT-7-2023-2(44)-10/08/4-M-08.

REMOVAL OF SAFRANIN O FROM WATER SAMPLES USING PLANT-BASED BIOMASS: ADSORPTION ISOTHERMS, KINETICS, AND THERMODYNAMICS STUDIES

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Biosorbents are biologically derived materials that stand out as a sustainable alternative in reducing environmental pollution and wastewater treatment. These materials are used to remove various pollutants, especially dyes. Dyes are toxic compounds that are widely used in textiles, food, leather, and many other industries and can cause water and environmental pollution by mixing with natural water resources. Removal of these substances from water is of great importance in terms of preventing environmental pollution and protecting human health. Biosorbents obtained from natural materials are effectively used in adsorption processes due to their high adsorption capacity against toxic substances in water, low cost, non-toxic structure, and biodegradability.

In this study conducted to remove Safranin O dye from water, leaves of the *Pyrus elaeagnifolia* plant were used as biosorbents. The structural and chemical properties of the biosorbent used were characterized by FTIR, SEM, and EDX analyses. In the adsorption experiments carried out in the batch system, the effects of adsorption parameters such as initial pollutant concentration (5-600 ppm), solution pH (2-12), temperature (25-45°C), adsorbent amount (50-650 mg), and stirring speed (50-300 rpm) on the adsorption efficiency and capacity were investigated. As a result of the study, the adsorption efficiency and capacity were found to be 84.43% and 60.79 mg/g under the determined optimum conditions (C_0=400 ppm, pH=natural (6.69), T=35°C, m=250 mg), respectively. It was observed that the stirring speed did not significantly affect the adsorption efficiency and capacity. In order to evaluate the adsorption mechanism, the kinetics studies were carried out using Pseudo First Order (PFO) and Pseudo Second Order (PSO) rate equations, and

it was determined that the adsorption process was more compatible with the PFO kinetic model. The compatibility of the equilibrium data at different concentrations with Langmuir, Freundlich, Temkin, and Linear isotherms was evaluated. As a result, it was determined that the most ideal isotherm representing the equilibrium distribution of adsorbates between the solid and liquid phases was the Linear isotherm. The system properties of the adsorption process were determined by the thermodynamic parameters of Gibbs free energy change (ΔG^0), enthalpy change (ΔH^0) and entropy change (ΔS^0). The calculated negative ΔG^0 value indicates that the adsorption process occurs spontaneously, the negative ΔH^0 value indicates that the process is exothermic, and the negative ΔS^0 value indicates that the disorder of the system decreases.

The biosorption process stands out as an effective alternative to traditional water treatment methods by providing an environmentally friendly solution without the need for chemical reactions. In this context, it was observed that the leaves of the *Pyrus Elaeagnifolia* plant, which has no industrial value, can be an effective adsorbent in the removal of toxic pollutants in wastewater.

SYNTHESIS AND CHARACTERIZATION OF CALCIUM ALUMINATE NANOPARTICLES FOR CONCRETE REINFORCEMENT

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Nanoparticles in cement and concrete represent a cutting-edge approach to enhancing both its mechanical properties and the hardening process. One particularly promising method to improve these properties involves utilizing additives which are made of compounds which are present in concrete. In this context, we focused on calcium aluminate as a potential additive for cement and concrete reinforcement. To synthesize calcium aluminate nanoparticles, the Pechini method—a modification of the sol-gel technique—was employed. This method involves forming a chelate of metal cations with hydroxycarboxylic acid, followed by polymerization with a polyhydroxy alcohol to create a homogeneous gel. The gel is then calcined at different temperatures to produce uniform nanoparticles, which are ideal for applications such as enhancing cement and concrete properties. The phase

composition evolution of the final products was monitored using an X-ray diffractometer (XRD). Morphology and particle size distribution were analyzed using a transmission electron microscope (TEM), while infrared spectroscopy (IR) was employed to understand the synthesis mechanisms. Synthesized calcium aluminate nanoparticles were investigated as concrete additive and they were shown to enhance compressive strength of concrete. These findings underscore the potential of calcium aluminate nanoparticles as a transformative additive in concrete.

APPLICATION OF SUSTAINABLE AGRICULTURE PRINCIPLES IN THE CONDITIONS OF TECHNOLOGICAL DEVELOPMENT OF THE AGRARIAN SECTOR OF KAZAKHSTAN

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The introduction of environmentally friendly technologies in the production of meat products helps to reduce the negative impact on the environment. Recently, Kazakhstanis have begun to favour Kazakh national cuisine more often because of its balance and waste-free nature. The main sign of the country's prosperity is the growth of per capita consumption of agricultural products, including meat and meat products. It is therefore necessary to pay more attention to the qualitative development of animal husbandry and the growth of its productivity. The long-term National sectoral programme for the development of dairy cattle breeding for 2018-2027 is designed to ensure the innovative development of sectors of the agro-industrial complex of Kazakhstan, including cattle breeding, the development of competitiveness of meat processing enterprises, which is an important factor in the food security of the state. The relevance of this direction is justified by the fact that the meat industry is an important branch of the agrarian sector and an integral part of the food security system of Kazakhstan. Industrial development of the meat industry requires new approaches to the creation of functional meat products. There is a need to carry out scientific research on the development and implementation of environmentally friendly technologies in the production of national meat products using vegetable raw materials. The main raw materials for the production of national products are horse meat, beef, goat meat and others. The results of some studies have shown that obtaining and preparation of combined meat products

from horse meat improve the nutritional value, physico-chemical parameters, as well as functional and technological properties of the finished product, improving their functional properties and further involvement in the production processes of food, in particular meat products, is relevant and constitutes the subject of this work. Kazakhstan has enormous potential for the effective development of livestock farming. Sustainable agriculture in Kazakhstan is based on the principles of environmental, social and economic sustainability, seeking to minimise the destructive impact on the environment and maintain biodiversity. Applying the principles of sustainable agriculture has the following benefits: conserving natural resources through sustainable use; improving soil fertility by using organic methods (crop rotation, composting), which helps to maintain and increase soil fertility; reducing environmental impact as sustainable agriculture minimises the use of chemical fertilisers and pesticides, which helps to reduce soil and water pollution; maintaining crop diversity and creating sustainable. The implementation of sustainable agriculture in Kazakhstan is implemented through the following methods and approaches aimed at increasing productivity and preserving ecosystems: the use of biotechnology to improve soil fertility without the use of chemicals that can negatively affect the environment; the introduction of a variety of crops in the fields to improve soil fertility and reduce the spread of pests (crop rotation).

Producing organic products that do not undermine ecological and biological diversity is an urgent challenge. At the department of 'Food Biotechnology' research work is carried out to improve the technology of national meat products using biotechnology methods.

SYNTHESIS AND RESEARCH OF A NEW ADSORBENT BASED ON CINNAMIC ACID AND GRAPHENE OXIDE

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Every minute our world produces a lot of waste that pollutes the ecosystem and has a devastating effect on human immunity. The synthesis of a new adsorbent that does not harm the environment but effectively performs its work becomes an environmental challenge.

Cinnamic acid and its derivatives, being a structural unit of lignin and widespread in nature, have a lot of positive qualities satisfying both the adsorption qualities of the new agent and antimicrobial ones. In recent years, there have been a lot of reports about the modification of this acid due to the improvement of its qualities. The resulting modifications were mainly used in medicine as an antioxidant, anti-inflammatory, and antimicrobial agent. The presence of hydroxyl, vinyl and carboxyl groups in the structure of cinnamic acids allows the use of these aromatic compounds in polycondensation reactions.

Graphene oxide, as one of the most common carbon nanomaterials of the 21st century, is one of the most sought-after precursors in the production of new materials. When obtained by the Hammer method, the surface of the graphite aromatic system is oxidized, which leads to the appearance of such oxygen-containing functional groups as hydroxyl, carboxyl and epoxy groups. The presence of these groups allows both covalently and non-covalently modifying the obtained graphene oxide nanolayers, allowing to obtain a nanomaterial with a wide range of properties. In addition, the presence of the above functions facilitates the use of graphene oxide and its modifiers to capture certain pollutants.

Based on the above, we have obtained a new adsorbent by modifying graphene oxide with cinnamic acid to obtain a new material. Functionalization was carried out through the substitution reaction of the hydroxyl group of cinnamic acid on a halogen atom followed by condensation with graphene oxide. The resulting compound was analyzed by methods of X-ray diffraction analysis of powders, IR spectroscopy and SEM.

INVESTIGATION OF MOLECULAR PROPERTIES OF AMINOBORANE DIMERS BY COMPUTATIONAL CHEMISTRY METHODS

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Aminoboranes are an important class of boron-nitrogen containing compounds that exhibit properties similar to alkenes by replacing the CC double bond with an isoelectronic and isoesteric BN bond. The fields of application of aminoboranes are quite wide and cover many current research topics. In materials chemistry, they are used both as monomers and intermediates in the catalytic synthesis of poly(aminoboranes).

In this study, tetraorgano-substituted aminoborane dimers AB1 and AB2 compounds were optimized at DFT-M062X/6-31+G(d,p) level. Optimized structures are given in Figure 1.

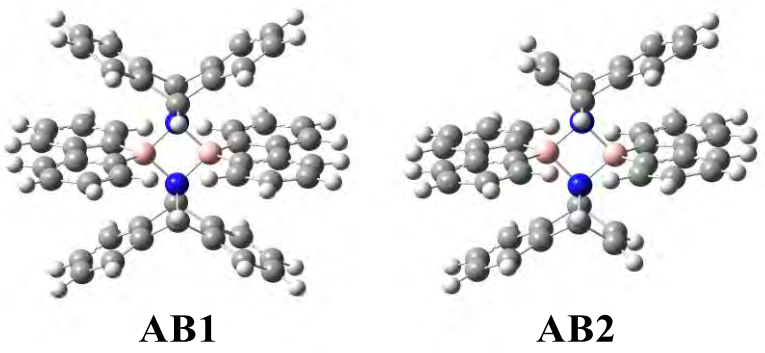

Figure 1. Molecular structure of the investigated tetraorganylaminoborane compounds.

The electronic properties (contour diagrams) and molecular electrostatic potential (MEP) maps of the compounds were examined to determine the active ends on the molecule. In order to estimate the molecular properties, some parameters such as HOMO energy (E_{HOMO}), LUMO energy (E_{LUMO}), ionization energy (I), electron affinity (A), energy gap (E_g), hardness (η) were calculated. The calculation results are given in Table 1.

Table 1. Some molecular descriptors of AB1 and AB2

	AB1	AB2
E_{HOMO} (eV)	-6.936	-6.960
E_{LUMO} (eV)	-0.361	-0.275
I (eV)	6.936	6.960
A (eV)	0.361	0.275
E_g (eV)	6.575	6.685
Ƞ (eV)	3.287	3.342

As seen in Table 1, the E_{LUMO}, I, E_g and η values of the compounds were higher for AB2, while the E_{HOMO} and A values were higher for AB1. Considering these results, it can be said that the AB2 molecule has a higher activity.

NEW CHALCONE SYNTHESIS WITH PENTANE-2,4-DIONE AND SALICYLALDEHYDE DERIVATIVE

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Kostanecki and Tambor coined the name "chalcones" to characterize a group of molecules that form the majority of physiologically active heterocyclic compounds. These chemicals are also known as benzylideneacetophenone or α-phenyl-β-benzoyl ethylene. They are an important class of organic compounds. Chalcones have two isomeric forms, the trans-isomeric form being the most thermodynamically stable. Flavanones can be synthesized from a three-carbon α, β-unsaturated system using the simple Michael addition cyclization technique, which connects two aromatic rings.

The Claisen-Schmidt condensation reaction is one of the most commonly used conventional reactions in organic chemistry due to its stability and simplicity of testing. This reaction is the most practical way to prepare chalcones. High-alkaline media such as NaOH, KOH, and Ba(OH)2 are commonly used as preparation media, as are natural phosphates.

Chalcones' α, β-unsaturated ketone system allows them to display a variety of biological functions. Numerous beneficial biological effects, such as cytotoxicity, anticancer, antibacterial, antifungal, and antioxidant qualities, have been studied and discovered. This is due to the fact that traditional medicine has made extensive use of collecting herbs. Many chalcones are now used to treat viral diseases, heart disease, parasite infections, pain, and stomach and gastrointestinal cancers, in addition to being used as food supplements and ingredients in cosmetic formulations.

In light of the aforementioned, a new chalcone was produced using the Claisen-Schmidt condensation reaction in a basic medium between pentane-2,4-dione and 2-hydroxy-3-nitrosalicylaldehyde. 1H, 13C, and DEPT NMR spectroscopy techniques were used to confirm the structure of the obtained chalcone. The biological activities of the novel chalcone were examined against a number of microorganisms in the following phase.

RATIONAL USE OF NATURAL RESOURCES: EXAMPLE OF BIOLUMINESCENT IMAGING AND BIOLUMINESCENT BIOSENSOR

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The exponential increase in human population and the fact that environmental pollutants are increasing at the same rate have made it essential to detect these pollutants with environmentally friendly and easily applicable methods and to take the necessary precautions. Especially considering that one gram of preventing pollution or a problem is equal to one kilogram of eliminating pollution or a problem, the importance of fast and reliable detection methods emerges. In this context, biological assays using biological systems are increasingly being used to detect problems. In this context, one of the common processes is the biological light process called bioluminescence, which is created by microorganisms inside the cell. This biological process, which is completely a product of microbial activity and consumes 20% of cellular energy, results in a change in the amount of bioluminescence depending on the presence and amount of various environmental pollutants. In the light of this basic principle, the amounts of bioluminescence that change depending on the presence and amount of pollutants allow us to reach very important data through the standard curves that have been created.

In addition to environmental pollutants, bioluminescence, which occurs as a natural process within the cell, is also used to determine the course of various cancer cases and the effectiveness of treatment techniques. In this way, living cells will be prevented from receiving unnecessary radiation, and one of the pollution factors will be prevented to some extent in terms of environment.

Increasing environmental pollution and unfortunately its natural consequences such as ozone layer thinning, global warming and climate change are very serious global problems that we are facing. For this reason, it is of great importance to detect increasing cancer cases without harming living beings and without polluting the environment. At the same time, detection of all factors that have the potential to pollute all habitats on the globe with bioluminescence, one of the biological imaging techniques where natural resources are used, is an important step for us to protect our future.

The Earth may be without us, but we cannot exist without the Earth and its optimal conditions. Every damage given to the Earth negatively affects the diversity and abundance of species, which are the insurance policy of nature. Therefore, data should be obtained to take the necessary precautions using natural sources such as bioluminescence.

THE EFFECT OF ALGINATE-BASED HYDROGEL COMPLEXES ON WHEAT (TRITICUM DURUM) DEVELOPMENT

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Wheat is a key agricultural crop that plays an important role in global food supply. Additionally, the development of this plant is closely linked to water, nutrient availability, and soil conditions. In recent years, the use of natural polymers has gained attention for the efficient use of water resources and the improvement of soil conditions. One of these polymers, alginate, is widely used to stimulate plant growth. Alginates-based hydrogels enhance the soil's water retention capacity, promoting deeper root development and strengthening the plant's resistance to water stress. At the same time, these complexes improve soil structure, stimulate root development, and facilitate the slow release of nutrients to the plant. These processes efficiently meet the plant's need for water and nutrients, accelerating its growth. Alginates also increase microbial activity in the soil, which helps the plant absorb nutrients more easily and effectively. Indole-3-acetic acid (IAA) is a type of phytohormone, commonly known as auxin, that plays a crucial role in plant development. IAA regulates cell elongation and division by softening the plant cell walls, stimulates root development, and accelerates plant growth. IAA helps plants respond better to stress and improves their ability to survive under various environmental conditions. Therefore, the use of IAA in plant development and agriculture holds significant potential for increasing crop yields and improving soil fertility. Seed priming is a treatment method applied to promote plant development and ensure high productivity. This technique enhances seed viability and improves germination rate, uniformity, and overall development through a specific pre-sowing treatment process. Seeds are treated with specialized chemicals (such as hormones, micronutrients, or plant growth regulators). These substances enhance seed germination potential and growth. Hormonal priming, particularly with auxins (mainly IAA) and gibberellins, accelerates seed germination. Seed priming also helps in the robust development of plant root systems, enabling better absorption of water and nutrients by the plant. The aim of our research is to study the effect of IAA and alginate combinations at different concentrations on the amounts of chlorophyll a, b, and carotenoids, which are essential for the photosynthesis process. In the experiments conducted, the local Azerbaijani wheat variety "Ravan" was used for seed

treatment. The seeds were primed with six different concentrations: 1) control (distilled water); 2) 0.01 g Alg; 3) 0.001 g Alg; 4) 10 μM IAA; 5) 10 μM IAA + 0.01 g Alg; 6) 10 μM IAA + 0.01 g Alg. The priming process was carried out at 4°C for 24 hours. The primed seeds were then sown in cocopeat substrate and irrigated with a hydroponic solution for 14 days. Experimental analysis revealed that the concentration of 10 μM IAA + 0.01 g Alg resulted in an increase in chlorophyll a, chlorophyll b, and carotenoids. The chlorophyll content is considered as an index of the total amount of light harvesting complex and the electron transport components, while the relative chlorophyll content is positively correlated with the photosynthetic rate. The results showed that the level of chlorophyll a increased by 11.52%, chlorophyll b by 33.14%, and carotenoids by 13.8% in the 10 μM IAA + 0.01 g Alg compared to the control group.

INVISIBLE INVADERS OF THE GULF OF IZMIR, MICROPLASTICS

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In the period called the Anthropogenic/Plastic Age, industrialized countries with high population density are the most exposed to the negative effects of microplastic pollution. This study aimed to determine the microplastic pollution levels in the Gulf of Izmir, on the Aegean Sea coast of Türkiye. With this aim, microplastic samplings were carried out seasonally over a period of 2 years (February 2022 to March 2024). Microplastics isolated from the sampling stations were classified according to their types, colors and sizes. Polymer types of microplastics were determined by ATR-FTIR spectroscopy. In terms of microplastic pollution, the quality grade of the sampling stations was determined using various indices such as MPI, PLI, PHI, PERI, and CMPI. A total of 1,160 microplastic particles were isolated as a result of samplings from the Gulf of Izmir. Filament-type (321 particles) and blue-colored (336 particles) microplastics were the most dominant type and color in the Gulf of Izmir, respectively. Microplastics with a size of 250-2.500 μm (619 particles) were the most dominant size range sampled from the Gulf of Izmir. According to the results of ATR-FTIR spectroscopy, polyvinyl chloride (PVC), polyethylene (PE), and polystyrene (PS) were detected as the most abundant polymer types of microplastics in the Gulf of Izmir. In terms of microplastic pollution, the quality grade of the Gulf of Izmir is classified as "polluted" by the MPI and PHI indices (22.2 and

53.1, respectively); "very polluted" by the PLI index (49.6); "extremely polluted" by the PERI index (2612.5); and "moderate" by the CMPI Filament-Fragment-Foam classification (0.26, 0.28, and 0.10, respectively). It is concluded that the Gulf of Izmir faces significant challenges from the perspective of microplastic pollution.

Acknowledgement: This research was supported by Scientific and Technological Research Council of Turkey (TUBİTAK, Project no: 121Y390).

DESIGN AND ANALYSIS OF NOVEL SUPRAMOLECULAR ASSEMBLIES BASED ON GRAPHENE OXIDE NANOLAYERS AND AZOMETHINES

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Schiff bases are compounds formed through the condensation reaction between aldehydes or ketones and amines, first reported by Hugo Schiff in 1864. These compounds have been extensively investigated for industrial applications, though their biological activity remains an area of growing interest. Schiff bases are known to exhibit a broad range of biological activities, such as antiviral, antibacterial, antimalarial, anti-inflammatory, and antiproliferative properties.

Nanomedicine, the application of nanotechnology in healthcare, requires a multidisciplinary approach that integrates physics, chemistry, biology, and medicine. Graphene oxide (GO) nanolayers, known for their biomedical potential, particularly in drug delivery systems, possess a unique structure. This structure features carbon atoms with epoxide groups on both sides of the sheet, along with carboxyl, carbonyl, and hydroxyl groups located near the edges. Currently, researchers are focusing on exploring the biological applications of GO nanolayers.

Building on these findings, this study aims to synthesize Schiff bases and develop supramolecular ensembles using graphene oxide nanolayers. The primary objective is to create novel biologically active compounds by synthesizing Schiff bases through the condensation reaction of 2,3 dimetoxy-1-naphthaldehyde with various amines, followed by their noncovalent functionalization with GO. The

structures of the synthesized Schiff bases were analyzed using ^{1}H and ^{13}C NMR spectroscopy.

The morphology and particle size of the resulting nanoparticles were characterized using scanning electron microscopy (SEM) and powder X-ray diffraction (XRD). Additionally, the newly synthesized Schiff bases were used to modify GO nanolayers, forming new ensembles whose structures were further examined using Fourier-transform infrared (FTIR) spectroscopy.

BIOSORPTION OF PB(II) FROM AQUEOUS SOLUTION USING *ECHINOPHORA SIBTHORPIANA* BIOMASS

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Heavy metal pollution is a global problem that poses a significant threat to human health and the environment. While some heavy metals are necessary for life, their intake above certain doses can lead to toxic effects. Heavy metals such as Pb(II) can harm living beings even in very low amounts. While Pb(II) can be removed from water by various methods, only some of them can be used in practice. Among these methods, the use of plant-based biosorbents is a research topic that is emphasized today due to their environmental friendliness and low cost.

In this study, the *Echinophora sibthorpiana* plant, which is widely found in Turkey, was used for the first time as a plant-based biosorbent, and Pb(II) removal experiments from aqueous solutions were carried out under various conditions. The effects of pH, pollutant concentration, time, biosorbent amount, and reaction temperature on Pb(II) biosorption were investigated. Structural and chemical changes in the biomass after biosorption were characterized by FTIR, SEM, and EDX analyses.

As a result of the study, the optimal conditions for achieving the highest removal efficiency were determined as follows: a solution pH of 5.8, a pollutant concentration of 50 ppm, a reaction time of 6 hours, a biosorbent dosage of 100 mg, and a reaction temperature of 25°C. Under these conditions, the removal efficiency

of Pb(II) exceeded 70%, demonstrating the potential effectiveness of the *Echinophora sibthorpiana* as an alternative to conventional adsorbents.

Acknowledgement: This work was supported by TUBITAK 2209-A project number 1919B012305235.

TOXIC EFFECTS OF *DATURA INNOXIA* MILL. LIGHT AND ELECTRON MICROSCOPIC STUDY

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Datura innoxia is an annual herbaceous plant of the Solanaceae family. This species is widely distributed in the territory of Azerbaijan. Species of the genus Datura are known as a source of tropane alkaloids. They have toxic and therapeutic effects. The main symptoms of datura poisoning are hallucinations, mydriasis, dry skin, dizziness, tachycardia, decreased urinary retention, etc. Various pathological changes in organs caused by the toxicity of tropane alkaloids were identified by light and electron microscopy methods and studied by various research groups. The main objective of this study is to determine the toxic effect of Datura innoxia Mill. seed extract on the structural elements of liver tissue of white laboratory rats at the ultrastructural level. In the presented research, datura seeds extract was prepared by using the acid-base extraction method and dissolved in 0.9% saline. The extract were orally administered by laboratory rats for 30 days at a dose of 5 mg / kg body weight once a day. After the end of the experiment, liver samples were obtained from the control and experimental groups and fixed with a mixture of 2.5% glutaraldehyde, 2.5% paraformaldehyde and 0.1% picric acid in a phosphate buffer (pH = 7.4). Araldite-Epon blocks were prepared according to the accepted protocols for electron microscopy. Semi-thin (1 μm) and ultra-thin (50-70 nm) sections were obtained by using an EM UC7 ultramicrotome (Leica, USA). The prepared sections were stained with methylene blue, azur II and basic fuchsin or toluoid blue and examined under a Primo Star light microscope (Zeiss, Germany) and a JEM-1400 transmission electron microscope (TEM) (JEOL, Japan). The results of the study revealed increased vascular permeability due to damage to the endothelial cells that make up the wall of the central veins and sinusoids. In the periendothelial and perivascular spaces, pathologies in the form of edema were detected.

Congestion in the lumen of the sinusoids and the presence of bridge-like connections between most of the sinusoids in the liver were detected. Necrosis was observed in the perivascular spaces of the veins. The membranes of hepatocytes were damaged, and cytoplasmic organelles migrated into the intercellular and Disse spaces. Glycogen in the cytoplasm of hepatocytes was transformed into an amorphous form, some nuclei of hepatocytes underwent dystrophy, tight contact of the bile ducts was disrupted, and sometimes was not visualized. Based on the obtained results, it was established that the extract we used, rich in alkaloids, at a dose of 5 mg/kg for 30 days leads to a toxic effect of the liver in white laboratory rats at the ultrastructural and histological level.

REDOX-MODULATION CAPACITY AND PHENOTYPING INHIBITORY POTENTIAL OF THE *PSEUDOMONAS AERUGINOSA* LAS/RHI QUORUM SENSING SYSTEM BY EXTRACTS OF *GEUM URBANUM* L. ROOTS AND AERIAL PARTS

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This study aimed to investigate the redox-modulating capacity and effect on the phenotype of the quorum sensing system of Pseudomonas aeruginosa ATCC 27853 by ethyl acetate (EtOAc) - separated methanolic extracts of aerial parts and roots of Geum urbanum originating from Bulgaria.

The quorum sensing (QS) signaling network determines the drug resistance of infectious bacteria. QS is a highly cell density-dependent gene expression regulatory system responsible for bacterial pathogenicity, such as biofilm formation, bacterial motility, pigment production, etc. We performed a QS assay to account for the effects of the two EtOAc extracts by determining the levels of pyocyanin formed. At the concentration range of ½ to ¼ of sub-minimal inhibitory concentrations of the extracts, the biofilm formation was inhibited with 85% and 84% by roots, and by 62% and 39% by aerial parts, respectively. At ½, ¼, and 1/8 sub-MICs the

pyocyanin synthesis was inhibited with 17-27% after treatment with EtOAc aerial parts extract and 26-30% - with roots. The motility was inhibited fully at ½ and ¼ sub-MICs. We investigated the inhibitory potential of LasI, LasR, RhII, and RhIR gene expression in biofilm and pyocyanin probes with the PCR method. Interestingly, we found only expression in the LasI gene at ¼ sub-MIC of EtOAcR extract in pyocyanin production probes.

Antiradical studies evaluated by DPPH, CUPRAC, and ABTS radical scavenging methods and superoxide anion inhibition showed that the leaves EtOAc have an effective antioxidant capacity.

These results can serve as future development of new amcomplexes as biocontrol agents that inhibit phenotyping of the QS system of P. aeruginosa and other antibiotic-resistant pathogens.

SPECTRAL STUDY OF THE ORGANIC COMPONENT OF AZERBAIJAN'S OIL SANDS AND THE FIRST ATTEMPT TO OBTAIN ALTERNATIVE FUEL

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Azerbaijan, along with its rich oil and gas reserves, also possesses significant resources of oil sands and combustible shales. Both onshore and offshore in the Caspian basin, these deposits demonstrate a wide range of geological age dynamics, but systematic evaluation of the possibilities for extracting synthetic hydrocarbons from these sands is limited.

In the present study, we aimed to evaluate the physical-chemical parameters of oil rock samples from the Rahim field, known for its large reserves, including their moisture content, bitumen concentration in their composition, and density. Using solvents, we extracted bitumen from these samples and determined parameters such as viscosity, ignition temperature, freezing temperature, and others. The extracted fractions underwent FTIR, ^{1}H NMR, UV, and luminescence spectroscopy analyses to study their chemical structures.

For the first time, laboratory vacuum pyrolysis experiments were carried out to assess the potential for obtaining synthetic fuel from the samples.

Our results showed that oil sands from the Rahim field contain 14% bitumen by weight. This high content indicates significant potential for use as an energy source. Analysis of the extracted products revealed a composition of 36.3% paraffinic hydrocarbons, 22.7% naphthenic hydrocarbons, and 41.5% aromatic hydrocarbons. Ultraviolet spectroscopic data highlighted the abundance of aromatic hydrocarbons, while luminescence spectra demonstrated that the bitumen contained mono- and bi-cyclic aromatic hydrocarbons, indicating its quality.

When compared with Alberta oil sands, the Rahim field's bitumen is closer to Brent crude in quality, possessing a higher API gravity (>15.56) and lower density. Preliminary experimental refinement within the 75–360°C range yielded 65% of the total product. Unlike Canada's famous oil sands, which are more suitable for diesel fuel production (<175°C, no heavy gasoline fraction was extracted), bitumen from the Rahim field can also serve as a raw material for heavy gasoline fractions.

THE EFFECTS OF ASCORBIC ACID, DPI, AND ROTENONE ON ROS METABOLISM DURING HALOTROPISM IN DIFFERENT *ARABIDOPSIS THALIANA* ECOTYPES AND THE EXTREME HALOPHYTE *SCHRENKIELLA PARVULA*

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Salt stress is a major abiotic factor limiting crop productivity worldwide and posing significant risks to global food security High soil salinity disrupts water uptake, ion homeostasis, and plant growth, reducing crop yields. As sessile organisms, plants must have to cope with saline environments. Plants have evolved adaptive mechanisms, including halotropism a directional root growth response that enables plants to avoid high-salinity zones in the soil. When plants sense salt ions in the soil, halotropism starts complex signaling networks, including hormonal regulation, ion transport, and reactive oxygen species (ROS) signaling. ROS plays a dual role as signaling molecules and stress mediators, helping to regulate root growth direction while managing salt-induced damage.

To investigate the role of ROS metabolism during halotropism in response to 200 mM NaCl, we performed 5-day experiments using different *Arabidopsis thaliana* ecotypes (Col-0, Wt-5, and Uod-7) and the extreme halophyte *Schrenkiella parvula*. To manipulate ROS levels, ascorbic acid was applied to reduce ROS

accumulation, rotenone was used to enhance ROS production specifically in root mitochondria, and DPI was used to inhibit NADPH oxidase activity.

The treatment of the NADPH oxidase inhibitor DPI did not result in a significant change in root orientation in any Arabidopsis thaliana ecotype or the extreme halophyte *Schrenkiella parvula* compared to the 200 mM NaCl group, although growth inhibition disrupted halotropismic response. By the 48th hour, no halotropism response measurements could be obtained from any genotype. The presence of rotenone, which increases ROS levels, enhanced the degree of halotropic orientation in all *Arabidopsis thaliana* ecotypes, including *Schrenkiella parvula*. However, no significant difference was observed between the halotropism response to rotenone and the response to 200 mM NaCl alone. The treatment of ascorbic acid produced varying effects across *Arabidopsis thaliana* ecotypes and the extreme halophyte *Schrenkiella parvula*. In the Col-0 ecotype, ascorbic acid altered root bending direction, causing the roots to orient toward the salt source. In the Wt-5 ecotype, ascorbic acid intensified the halotropism response to 200 mM NaCl but did not affect the root orientation. For the Uod-7 ecotype, ascorbic acid mitigated the halotropism response without affecting the orientation. In *Schrenkiella parvula*, ascorbic acid did not alter the direction of the halotropism response but significantly intensified its strength.

INVESTIGATION OF THE AMOUNT OF CHLOROPHYLL IN NATIVE AND IMPORTED GENOTYPES OF SOYBEANS *(GLYCINE MAX).*

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The biggest and most populated nation in the Southern Caucasus, Azerbaijan, is home to over 9.3 million people and occupies an area of roughly 86,600 km^2. The lush soil and varied climate of Azerbaijan, which is home to one of the major genetic hubs in the world, support an astounding range of plant genetic resources. Approximately 65% of the floral variety in the Caucasus area is represented by the 4,500 higher plant species that are known to exist in the nation, including 210 endemic species.

The edible seed of the soybean (*Glycine max*), an annual legume belonging to the Fabaceae family of peas. As a source of vegetable protein for millions of people and a constituent in hundreds of chemical goods, the soybean is the most

commercially significant bean in the world. Although the soybean plant's origins are unknown, many botanists think it was initially domesticated as early as 7000 BCE in central China. Since ancient times, the soybean has been utilized as a food and ingredient in medicines in China, Japan, and Korea. In the middle of the 20th century, soybeans gained significant importance in the Midwest and South after being brought to the US in 1804. Argentina and Brazil also produce a lot.

In Saray Station, 42 local and introduced soybean genotypes were planted and various morphological indicators were studied. The genotypes with highest and lowest of total chlorophyll content were determined. Additionally, different morphological characteristics were observed between the genotypes. For example, the Canadian genotypes were taller, but the Uzbek genotypes were shorter. As a result of measurements made with the SPAD 502 device, it was observed that the Canadian genotypes Canada-4 and Canada-5 had higher chlorophyll content.

These studies have provided valuable information for preserving genetic diversity and increasing productivity in soybeans of different origins. Also, preserving genetic diversity based on different geographical sources is considered an important step in plant breeding and agriculture. These studies constitute a fundamental source for rapid development and efficient breeding in soybean.

ASSESSMENT OF ANTICANCER ACTIVITY OF *C. ORIENTALIS* FLOWER ETHANOL EXTRACT: MOLECULAR MODULATION OF *PAX6* AND *MDR (ABCB1)* IN AGS AND HS-738.ST/INT CELL LINES

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Consolida orientalis (C. orientalis), a member of the Ranunculaceae family, naturally grows in various regions worldwide. Its rich phytochemical content, including phenolics and alkaloids, contributes to its diverse biological activities.

This study aimed to evaluate the effects of the ethanol extract of *C. orientalis* flowers on AGS (gastric adenocarcinoma) and Hs-738.St/Int (normal human intestinal fibroblast) cell lines, as well as to analyze the expression profiles of *PAX6* and *MDR (ABCB1)* genes.

The *C. orientalis* plant used in the study were collected in June-July 2023 from Imaret village, Sivas, located at coordinates 39°41'40"N, 37°02'25"E, at an altitude of 1400 meters. The taxonomic identification of the collected specimens was performed by Prof. Dr. Yavuz Bülent Köse, a faculty member of the Faculty of Pharmacy at Anadolu University. The collected *C. orientalis* plant was assigned the herbarium number 16195, labeled, registered, and preserved in the Herbarium of the Faculty of Pharmacy at Anadolu University. In the study, plant extracts prepared from the flower parts of *C. orientalis* were used, and the ethanol extract was applied to AGS and Hs-738.St/Int cell lines at eight different concentrations (0.5–250 µg/mL). Anticancer activities were determined using the MTT assay. The cell lines were cultured in MEM medium containing 10% fetal bovine serum (FBS) and penicillin (100 U/mL) in an incubator with 5% CO2 and 95% humidity at 37°C. The IC_{50} doses of the plant components were found to be 113.8 µg/mL at 24h, 53.14 µg/mL at 48h, and 26.06 µg/mL at 72h. RNA was isolated from the cells, cDNA synthesis was performed, and the expression levels of *PAX6* and *MDR (ABCB1)* genes were analyzed using the $\Delta\Delta^{Ct}$ method on an RT-PCR device.

The results showed that when *C. orientalis* extract was applied alone, the expression of the *PAX6* gene in AGS gastric cancer cells was found to be significantly higher compared to Hs-738.St/Int healthy control cells. However, while the *MDR (ABCB1)* gene showed a 4.41-fold increase in gastric cancer, this increase was not statistically significant.

These findings suggest that *C. orientalis* may potentially play an important role in gastric cancer cells, particularly in the regulation of *PAX6* and *MDR (ABCB1)* genes, and could be effective in preventing the progression of gastric cancer. However, further research is needed to explore this as a potential new strategy for preventing cancer progression.

ADDRESSING GLOBAL ENVIRONMENTAL ISSUES THROUGH SUSTAINABLE AGRICULTURAL PRACTICES: THE ROLE OF GAMMA-IRRADIATED CHITOSAN IN CROP PRODUCTION

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Global environmental challenges, including climate change, pollution, and resource depletion, require urgent action to ensure sustainable food production. Agriculture, a key driver of these issues, must adapt to meet growing food demands while minimizing ecological impact. This study explores the potential of gamma-irradiated low molecular weight chitosan (LMW) as an eco-friendly biostimulant for enhancing agricultural productivity. Chitosan, a natural biopolymer derived from crustacean shells, offers an alternative to synthetic agricultural inputs. This research investigates the effects of gamma-irradiated LMW chitosan on wheat seed germination and growth.

Commercial chitosan was subjected to 50 kGy gamma radiation, reducing its molecular weight from 310 kDa to 22.4 kDa. Wheat seeds were treated with varying concentrations of irradiated chitosan (0.05%, 0.1%, and 0.2%) and germinated under controlled conditions. Key metrics such as germination energy, germination percentage, and seedling growth were assessed. FTIR analysis was performed to evaluate structural changes in chitosan, while viscometric analysis measured molecular weight reduction.

The irradiated chitosan significantly improved wheat seed germination. The highest germination energy (87.8%) and germination percentage (89.5%) were achieved with a 0.2% concentration of irradiated chitosan. FTIR analysis confirmed that irradiation induced chemical changes, such as an increase in C-H bonds and a decrease in C-O-C bonds, indicating chain termination. Regarding the degree of deacetylation (DD), there is a difference of only 0.13% between low molecular weight and commercial chitosans, indicating that gamma irradiation does not significantly affect the degree of deacetylation.

Gamma-irradiation of chitosan reduced its molecular weight, improving its solubility and bioactivity, which in turn enhanced the germination and growth of wheat seedlings. The positive effects observed with 0.2% irradiated chitosan suggest that gamma-irradiated chitosan can serve as an effective biostimulant in sustainable agriculture, improving crop productivity while reducing reliance on synthetic chemicals. These findings align with the need for sustainable agricultural solutions that minimize environmental damage.

This study demonstrates that gamma-irradiated low molecular weight chitosan is a viable, eco-friendly alternative to traditional agricultural inputs. Its ability to enhance germination, seedling vigor, and stress tolerance positions it as a promising tool for sustainable agriculture. Further research should focus on optimizing irradiation doses, testing different plant species, and evaluating the economic viability of large-scale application in agriculture.

SYNTHESIS OF NEW INDENONE DERIVATIVE COMPOUNDS AND INVESTIGATION OF THEIR VEGFR2 INHIBITORY PROPERTIES USING IN SILICO METHODS

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Cancer, caused by uncontrolled cell growth and proliferation due to a combination of various factors such as genetic mutations, cellular abnormalities, and environmental influences, is one of the leading causes of death worldwide. Gastric cancer, influenced by factors such as environmental conditions, dietary habits, and infections (mainly *Helicobacter pylori*), is the fifth most common cancer globally and ranks third in cancer-related mortality. Due to its widespread incidence and high mortality rate, it has been extensively studied. Our study focuses on VEGFR-2 expression, which has been reported by researchers to be associated with the stage of gastric cancer and the number of blood vessels. Angiogenesis is essential for tumor growth and metastasis, providing the necessary blood supply for tumor nourishment and expansion. VEGFR-2 is a tyrosine kinase receptor responsible for angiogenesis in gastric cancer. Studies have shown that inhibiting VEGFR-2 can prevent the proliferation of gastric cancer cells and potentially alter the disease's progression. Indenones hold a significant place in pharmaceutical research as bioactive molecules. These compounds exhibit various biological activities, particularly standing out for their anticancer, anti-Alzheimer, antimicrobial, and antiviral effects. Numerous studies have demonstrated their efficacy against various cancer types, including resistant cell lines. Evaluating the ability of indenones to target angiogenesis-related receptors such as VEGFR-2 and suppress new blood vessel formation is a valuable focus of our research. It is known that fluorine atoms facilitate interactions within biological systems and bind to the active sites of enzymes.

Moreover, fluorine-substituted indenones have garnered attention for their potential as VEGFR-2 inhibitors. These molecules may inhibit cancer progression by targeting the energy metabolism and proliferation of cancer cells. In our study, eight novel indenone derivatives were synthesized and characterized. The chemical structures of these compounds were confirmed using spectral methods (IR, 1H-NMR, 13C-NMR) and optimized using computational chemistry techniques. Additionally, the electronic properties and VEGFR-2 inhibitory activity of the compounds were investigated through in silico methods. It was determined that the molecules examined inhibited VEGFR2 and their ADME properties were suitable for drug potential.

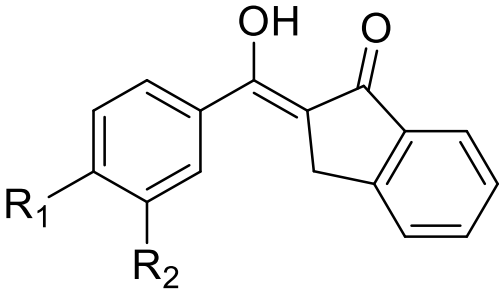

Fig. 1. General structure of investigated molecules

MOLECULAR INSIGHTS INTO PLATINUM (IV) COMPLEXES: DFT ANALYSIS AND DOCKING STUDIES FOR ENHANCED ANTICANCER ACTIVITY

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The six-coordinated Pt1, Pt2 and Pt3 complexes were analyzed by computational chemistry methods to evaluate them at the molecular level and to determine their advantages over the four-coordinated complexes. The most suitable calculation level was performed by benchmark analysis using experimental bond lengths. The most suitable level was determined as WB97XD/6-31G(d,p)/SDD. Spectroscopic data (IR, 1H- and 13C-NMR) were calculated for the structural analysis of Pt1-Pt3 complexes and compared with the experimental results. HOMO and LUMO contour diagrams and MEP maps, which provide important information for the

electron exchange of the complexes, were visualized. These data provide useful information for predicting the structures they will form with biological receptors. Molecular docking was performed to evaluate the biological activities of the studied platinum (IV) complexes (Pt1-Pt3) compared to platinum (II) complexes from current chemotherapy drugs. Pt1-Pt3 complexes were docked with proteins representing cancer cells PDB ID: 1JNX (breast cancer), PDB ID: 1X2J (lung cancer) and PDB ID: 2HQ6 (colon cancer). The studied complexes were found to be more advantageous in terms of anticancer compared to the reference cis-Pt complex.

EFFECT OF NO INDUCTOR ON NO AND CHLOROPHYLL CONTENT OF DURUM WHEAT (TRITICUM DURUM) UNDER DROUGHT AND SALINITY STRESS

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Rising global temperatures lead to decreased precipitation, prolonged droughts, and increased soil salinity. All these create major environmental challenges, like drought, salinity. These changes affect ecosystems and threaten agriculture.

Throughout life cycle of plants, they face different of environmental stresses that can impact their growth and development. Under stressful conditions, plants generate increased levels of ROS, which are involved in regulating key processes such as pathogen defense, programmed cell death. These reactive molecules can significantly influence the development of tissues and organs, often resulting in abnormal growth or even plant death. While small amounts of ROS improve plant development and stress responses, excessive ROS production can be harmful, leading to cellular damage and cell death. Plants regulate ROS levels through scavenging enzymes like catalase, peroxidase, and polyphenol oxidase and and antioxidant substances (vitamins C, E, proline, glutathione, etc.) which help neutralize excess ROS and maintain cellular stability.

Nitric oxide (NO) serves as a signaling compound in plants and can be produced non-enzymatically from sources like sodium nitroprusside (SNP). It participates in processes, such as gene regulation, programmed cell death and stress adaptation. It also neutralizes harmful radicals and triggers antioxidant defenses by increasing enzyme activity and gene expression. Studies have shown that application of exogenous SNP increases the activity of antioxidant enzymes and substances, making plants more tolerant to harsh conditions.

Our study examines the impact of 0.2 mM SNP on NO levels and chlorophyll content in *Triticum durum* (durum wheat) under drought and salinity stress. The findings suggest that NO content was highest under 100 mM NaCl + 0.2 mM SNP treatment, while significantly reduced NO levels was observed in both 3% PEG and 3% PEG + 0.2 mM SNP. Similarly, chlorophyll a, chlorophyll b, and carotenoid levels were highest in 100 mM NaCl + 0.2 mM SNP treatments, but lowest under 3% PEG treatments. These results suggest that application of 0.2 mM SNP improves stress tolerance of *Triticum durum* under salinity stress, in compare to the drought stress, and the addition of SNP helping to minimize losses and improve resistance.

DEVELOPMENT OF A POLYETHYLENE GLYCOL(PEG)/ GLYCEROL-BASED INJECTABLE BONE GRAFT CONTAINING DIFFERENT SIZES OF 45S5 BIOACTIVE GLASS

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Bioactive glasses (BG) are inorganic bone graft materials that can bind/interact with bone. Although various BG have been developed, the most known BG type is 45S5. However, these BG in powder or granule form have limitations such as not being filled in the desired volume and shape in the bone cavity. For this reason, it is necessary to need a putty-like injectable bone graft that an easily take the shape of the cavity area. It is well known that the FDA approval of polyethylene glycol (PEG) allows it to be used in bone defect applications.

Here, we prepared injectable bone grafts with a PEGs/Glycerol/45S5 composition for use in bone defects. Firstly, 45S5 BG were produced by melt-quenching method and grounded and sieved in the different sizes. Then, these grafts were produced by mixing PEG polymers with different average molecular weights and glycerol with different sizes of 45S5 in different ratios. Grafts were then subjected rheology experiments for injectiablity features and the *in vitro* bioactivity behaviour of the these grafts in simulated body fluid (SBF) for up to 28 days was investigated by FTIR, SEM and XRD analyses and ion release was investigated by ICP-OES.

According to the results obtained in incubation SBF, Ca-P deposition on the surfaces of BG and crystalline HA/HCA deposition on the surface of BG which are indicators of in vitro bioactivity properties of all injectable bone grafts produced, were observed from the 7th day. According to the ICP-OES results, the increase in

Si and Ca ions in the first 7 days of the grafts in SBF and the decrease in Si ions in the following days indicate HA/HCA accumulation on the surface. In addition, it was observed that the samples containing a high content of bioactive glass had a higher degree of bioactivity. It was observed that all samples had viscoelastic and pseudoplastic fluid properties. All these studies have shown that bone grafts with high amount and smaller size bioactive glasses are injectable and have high bioactivity.

Acknowledgement: This work has been supported by Yildiz Technical University Scientific Research Projects Coordination Unit under project number FBA-2023-5377

ANTIPARASITIC EFFECT OF Fe_3O_4 NANOPARTICLES. LIGHT AND ELECTRON MICROSCOPIC STUDY

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In recent years, nanotechnologies have attracted attention and are widely used in a number of fields, including medicine and biology. The fact that the sizes of metal nanoparticles are small and shows various physicochemical, antibacterial and antiparasitic properties has led to their use against a number of diseases and their agents. *H. dispar* nematode parasitizes domestic waterbirds and causes serious damage to the host organism. From this point of view, the search and application of new means of treatment remains relevant. Therefore, the aim of this study is to investigate the migration, bioaccumulation and pathological changes caused by Fe_3O_4 nanoparticles in the body of *H. dispar* nematode by light and electron microscopic methods. Nanoparticles were synthesized at Baku State University using a chemical method. Helminths were monitored *in vitro* by keeping 15 nematodes in each Petri dish (3 pieces) and placing them in a thermostat at 42-43 C. Physiological solution (control group) was used in one of the vessels, while Fe_3O_4 was used in concentrations of 50 and 100 μg/ml in the others. After the parasites were fixed, Araldite-Epon blocks were prepared according to the general accepted protocols in electron microscopy. Semi-thin (1-2 μm) sections were obtained from the blocks using an EM UC7 (Leica) ultramicrotome, then viewed under a Primo Star (Zeiss) light microscope and photographed using an EOS D650 (Canon) digital camera. Ultrathin sections were examined under a JEM-1400 transmission electron microscope (TEM) operating at 80-120 kV and electrograms were recorded. As a result

of different morphometric analyses conducted by ITEM revealed that the size of the nanoparticles used in the experiments is 8.04-17.95 nm (11.90±0.41 nm). At the dose of Fe_3O_4 50 μg/ml, helminths weakened 1.5 times faster at a concentration of 100 μg/ml, they weakened 2.25 times faster than the control group. The complete destruction of parasites was determined to be 1.8 and 2.5 times faster, respectively. As a result of the research, it was found that Fe_3O_4 nanoparticles bioaccumulate in the body of the parasite by entering through the digestive organs and body wall tissue. The size of nanoparticles found in the parasite organism was 10-12 nm. In addition to the above, pathological changes caused by nanoparticles in the parasite's body were also studied. The boundary between the layers of the cuticle, which consists of eight layers, was not distinguished in some places. The structure of the tubular structures located between the cuticle and the hypodermis was damaged. The unevenly distributed glycogen in the hypodermis had been used up due to stress, and the parts where they located were changed to an amorphous form and formed transparent areas. Vacuolization was observed in the sarcomeres of the muscular layer of the helminth. Numerous large vacuoles formed in the cytoplasm of the epithelial cells in the intestinal wall of the parasite. In addition, as a result of the fragmentation of the membranes of many cytoplasmic structures, myelin-like bodies were observed. The membranes of some of the microvilles located in the part of the intestine were damaged. During the TEM study of the female worm, the basal lamina of the uterus wall thickened, and small vacuoles formed in the cytoplasm of epithelial cells. In the cytoplasm of the oocytes, transparent areas increased.

ANTICANCER ACTIVITIES OF *S. ROTUNDIFOLIUM* ETHANOL EXTRACT (AERIAL PARTS) AND ITS IMPACT ON *KCNQ1OT1* AND *MEG3* GENE EXPRESSION IN HT-29 AND CCD-18CO CELL LINES

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There are 38 species of *Smyrnium rotundifolium* (*S. rotundifolium*) in the world and it represents a group of 6 taxa. These taxa are known as the root group of plants and have a laxative and diuretic function.

The study aimed to investigate the anticancer activities of *S. rotundifolium* ethanol extract (aerial parts) and its effect on *KCNQ1OT1* and *MEG3* gene expression in HT-29 and CCD-18Co cell lines.

S. rotundifolium plant used in the study was collected between June and July 2023 in Sivas İmaret village at an altitude of 1400 meters at the coordinates of 39°41'40"N, 37°02'25"E. Taxonomic identifications of these collected samples were made by Prof. Dr. Yavuz Bülent KÖSE, Faculty of Pharmacy, Anadolu University. Plant samples collected from Anadolu University Faculty of Pharmacy were labelled by giving their herbarium number (*S.rotundifolium*: 16196). In this study, *S. rotundifolium* was prepared from the aerial parts. The collected plant sample was applied to HT-29 and CCD-18Co cell lines at eight different concentrations (0.5-250 µg/mL) for 24h, 48 h and 72h and their anticancer activities were determined by the MTT method and the IC_{50} value was calculated. The IC_{50} doses of plant components were found to be 28.48 µg/mL at 24h, 16.47 µg/mL at 48h and 9.41 µg/mL at 72h. At the end of 48h, the determined IC_{50} value was applied to the cells and left for incubation, and then RNA was isolated according to the kit protocol and cDNA was synthesized from the obtained RNAs. The expression levels of the plant sample were analysed using the $\Delta\Delta^{CT}$ method in the RT-PCR device.

When the results were evaluated, when *S. rotundifolium* extract was applied alone, *KCNQ1OT1* gene expression in HT-29 colon cancer cells was found to be significant compared to CCD-18Co healthy control cells. Despite a small increase in the *MEG3* gene, no significance was detected.

These findings suggest that *S. rotundifolium* may play an important role in colon cancer cells, especially in the regulation of *KCNQ1OT1* and *MEG3* genes, and may have an effect in preventing the progression of colon cancer. However, new research is needed for preventing cancer progression and a new strategy.

SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL ACTIVITY STUDIES ON BENZAMIDE COMPOUND

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The amide functional group is essential to the structure of many biologically active molecules, such as proteins and peptides, as well as a broad range of chemical probes, clinically authorised pharmaceutical compounds, and experimental synthetic and natural product molecules. As such, medicinal chemists and chemical biologists are quite interested in the amide functionality. The amide group's exceptional capacity to create pertinent hydrogen bonding interactions has drawn a lot of attention.

As the fundamental building block of life and the pharmaceutical industry, amide bond formation is arguably the most essential and ubiquitous change among the more significant processes in organic synthesis due to amides being one of the most prevalent functional groups among bioactive molecules. The most common synthetic access to amides is provided by the reaction between a suitably functionalized carboxylic acid with a suitably functionalized amine. At the bench, to increase yields, shorten reaction times and react sterically hindered or other low reactivity substrates, the most frequently employed method for the preparation of amides involves the reaction of an activated carboxylic acid derivative, such as acid chlorides, anhydrides or esters, with amines. Taking all these into account, we synthesized a new type of amide compound N,N'-((ethane-1,2-diylbis(oxy))bis(ethane-2,1-diyl))bis(4-chlorobenzamide) using benzoyl-chloride derivative and polyamine 2,2'-(ethane-1,2-diylbis(oxy))bis(ethan-1-amine). Utilizing mass spectroscopy, ^{1}H, and ^{13}C NMR, and elemental analysis, the structure of the generated molecule was investigated. The synthetic organic compound's biological activity has been examined against a range of gram-positive and gram-negative bacteria, including Staphylococcus aureus, Escherichia coli, Acinetobacter baumannii, Klebsiella pneumoniae, and Pseudomonas aeruginosa. It was demonstrated that the new amide had a more effective inhibitory effect than the common antibiotics, cefotaxime and ceftriaxone.

Acknowledgement: This work was supported by the Azerbaijan Science Foundation-Grant No AEF-MCG-2023-1(43)-13/09/3-M-09

SYNTHESIS OF ACRIDINE DERIVATIVES, DFT CALCULATIONS AND DETERMINATION OF THEIR EFFICACY AGAINST TOPO I USING *IN SILICO* METHODS

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Cancer is an important disease that causes mortality all around the world. Cancer, due to structural reasons, genetic and environmental factors cells in certain parts of the body grow uncontrolled and abnormal as a result of mutations and abnormal growth in DNA. It is a disease caused by constant proliferation. When cells are exposed to cancer-causing factors for a long time, some mutations develop in the cells. These mutations cause cancerous changes in cells. These types of abnormal cells can develop in anyone, but an adequate immune system recognizes and repairs or eliminates these cells. As a result of a weakness in the organism's immune system, uncontrolled proliferation increases in cells whose structure is damaged and cancer masses form. Cancer cells continue to multiply without stopping. One of the protein-based enzyme groups that play an important role in cell proliferation is topoisomerases. One of the subtypes of this group found in humans is topoisomerase I. During DNA self-replication, it binds to DNA with covalent bonds and opens supercoils, reducing stress and preventing DNA from breaking. It converts DNA into isomers with different structures by cutting the chains and recombining them. At this point, topoisomerase enzymes are an important target in cancer treatment. If topoisomerase activity can be inhibited, excessive stress occurs in DNA during replication, leading to DNA breakage. Thus, the cell undergoes apoptosis and cancerous cell death is ensured by preventing uncontrolled cell proliferation.

In this study, acridine derivative compounds were synthesized with the aim of having a stronger therapeutic effect and fewer side effects. Firstly, full optimization calculations of the compounds were carried out at the M062X/6-311+G(d) level. Computational IR and NMR spectra were obtained and spectral data were revealed by DFT methods. The structural and electronic properties of the molecules in question were determined. Contour diagrams and molecular electrostatic potential maps of the HOMO and LUMO of these compounds were presented to determine their electronic properties. The indicated compounds were experimentally synthesized and characterized by spectral techniques (IR, 1H-NMR, 13C-NMR and

LC/QTOF-MS). In addition, the activities of the synthesized compounds against TOPO I; molecular docking was determined by ADME, MM-GBSA and p450 cytochrome analyses. The designed molecules were found to be active against the target protein. In addition, it was observed that their pharmacokinetic properties increased their potential as a drug.

ULTRASTRUCTURAL CHARACTERISTICS OF BLOOD VESSELS SUPPLYING THE DENTICULATE LIGAMENTS OF THE SPINAL CORD

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The ultrastructural features of the vessels involved in the nutrition of the dentate ligaments, different from the vessels of the dura mater of the spinal cord from which they originate, were studied. Among the cellular elements, collagen and elastic fibers of the denticulate ligament only blood vessels related to the microcirculation system were found: arterioles, capillaries, postcapillary and collecting venules. While the inner layers of the arterioles with the central part where nuclei are located of the somatic endothelial cells form thickenings toward the lumen of the vessel, a smooth lumen surface is determined in the remaining vessels. There are no noticeable differences in the thickness of the perinuclear, peripheral and intercellular communication zones of the endothelial cells of the arterioles. In all the others areas, except previous mentioned one, there are single mitochondria, granular endoplasmic reticulum, free ribosomes, and individual caveolae. The location of cytoskeletal elements and cytoplasmic glycoproteins in the area of intercellular connections somewhat increases their osmiophilicity. At the same time, between the plasmalemmas covering the adjacent areas of endotheliocytes, there are 2-4 connection points, characteristic of tight junctions. The endothelial layer of arterioles is continuously surrounded from the outside by the central and peripheral parts of primitive smooth muscle cells (PSMC). Between the described endothelial cells and primitive smooth muscle cells, a three-layer basement membrane is formed as a result of the fusion of their basal surfaces. It should be noted that the structures related to the basement membrane are not found at the levels of myoendothelial connections, which, although in small quantities, but present. At the level of the plasmalemma of primitive smooth muscle cells there are cluster-like

accumulations of caveolae and dense bodies, from which actin fibers originate. The lumens of the capillaries located in the denticulate ligament are surrounded by the central and peripheral parts of endothelial cells (up to 4). The cytoplasm of endothelial cells contains pinocytotic vesicles, single ribosomes, clathrin-coated vesicles, lysosomes, and endosomes. Endothelial cells are connected to each other by tight junctions, which have one to four connections. One of the important features of the capillaries of the denticulate ligament is that the endothelial layer is surrounded on all sides by pericyte cells. Unlike arterioles and capillaries, postcapillary and collecting venules are surrounded by at least five endothelial cells. The predominance of uncoated pinocytotic vesicles in contact with the luminal and abluminal parts of the plasma membrane of endothelial cells in the described vessels, as well as the presence of simple and coated pinocytosis along with micropinocytosis in their cytoplasm (especially in collecting venules) indicates that their permeability is higher than that of arterioles and capillaries. Another characteristic feature of postcapillary and collecting veins is that their endothelial layer is not surrounded on all sides by pericytes. Unlike the dura mater of the spinal cord, the absence of fenestrated endothelial cells, open connections between them and the detection of lymphatic vessels in the denticulate ligaments indicate that they play the role of a biological barrier.

ROSA DAMASCENA MILL. ESSENTIAL OIL: ANALYSIS OF *IN VITRO* AND *IN VIVO* GENOTOXIC AND CYTOTOXIC POTENTIAL EMPLOYING THREE CYTOGENETIC ENDPOINTS

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The highly valued oil of *Rosa damascena* Mill. (Rosaceae), widely used in high perfumery, cosmetics, and other spheres of human life oblige us to know and study the product's safety profile obtained from the water-steam distillation of fresh rose petals. That predetermined the object of the present study - to evaluate, through classical cytogenetic methods, the possible cytotoxic/genotoxic activity changes of

R. damascena Mill essential oil (EsO) in three different test systems: plant root meristem cells, mammalian bone marrow cells, and human lymphocytes. The *R. damascena* essential oil showed varying concentration- and time-dependent cytotoxic and genotoxic effects depending on the test system used as it was established moderate cytotoxicity in lymphocyte cultures and non-high cytotoxicity in ICR mice but none in barley. Both barley and human lymphocytes showed a genotoxic effect with a dose-dependent increase in chromosomal aberrations (CA) and a substantial rise in micronucleus (MN) frequency, while no genotoxicity was observed in bone marrow cells. Human lymphocytes *in vitro* exhibited the highest susceptibility to cytotoxic and genotoxic action of *R. damascena* EsO. This study supports the potential use of rose oil as a complementary therapy and a synergistic cytotoxic component in combating cancer cells.

ALTERNATIVE SPLICING AND THE FORMATION OF IDENTICAL ISOFORMS IN PLANT GENOMES

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The original goal of alternative splicing is to increase proteomic diversity, as this post-transcriptional modification enables the formation of multiple isoforms from a single gene. This process makes genomic space utilization more efficient. Studies indicate that alternative splicing is an evolutionarily advantageous mechanism compared to complete gene duplication, as the latter often leads to the rapid accumulation of deleterious mutations and the loss of gene functionality. In addition to generating functionally novel isoforms, alternative splicing can result in isoforms that are identical or synonymous in nucleotide sequence. One mechanism responsible for this is mutually exclusive splicing, a special type of splicing where only one of two exons is included in the isoform, with the inclusion of one necessarily excluding the other. Duplicated exons involved in mutually exclusive splicing can give rise to identical amino acid sequences. To investigate identical isoforms across various organisms and the splicing mechanisms responsible for their formation, we utilized genome and protein data from the open RefSeq repository. All data processing scripts were written in Python, and the BLAST+ software package was employed for sequence analysis, enabling the identification of similar sequences and the confirmation of identical isoforms.

In our study, we analyzed the genomes and isoforms of various plants. We found that mutually exclusive splicing is not the sole source of identical isoforms.

Other complex, combined mechanisms of alternative splicing that lead to synonymous mRNAs from a single gene were also identified. The frequency of these identical isoforms, expressed as a percentage of the total number of isoforms in the organism, was: Arabidopsis thaliana (0.019), Brassica napus (0.013), Brassica rapa (0.033), Malus sylvestris (0.074), Prunus persica (0.018), Triticum aestivum (0.021), Triticum urartu (0.012). We also explored potential mechanisms behind the preservation of identical isoforms. A comparison of 3′- and 5′-untranslated regions (UTRs) revealed no significant differences in mRNA secondary structures that could explain variations in isoform life spans. The most likely explanation for their persistence is their role as a reservoir for future mutations and their participation in neofunctionalization. In the future, we plan to study and compare the expression of identical isoforms and investigate their roles in the translatome composition of various organisms.

SYNTHESIS OF NEW NICOTINAMIDE-BASED CARBOXYLIC ACID DERIVATIVES AND INVESTIGATION OF THEIR POLY (ADP-RIBOSE) POLYMERASE (PARP) INHIBITOR PROPERTIES BY IN SILICO METHODS

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Cancer is the uncontrolled and continuous proliferation of cells due to DNA damage. DNA damage can result from genetic or environmental factors. Gastric cancer is among the cancer types with high incidence and mortality rates. Factors such as poor dietary habits, infectious agents, atrophic gastritis, and smoking can contribute to the development of gastric cancer. DNA damage in healthy cells can be repaired through various repair mechanisms. However, in cancerous cells, these repair mechanisms do not function properly. Genes involved in DNA repair can be targeted for cancer therapy. Poly (ADP-ribose) polymerases (PARPs) are a family of enzymes involved in DNA strand break repair pathways, utilizing nicotinamide adenine dinucleotide (NAD+) as a substrate. Eighteen members of the PARP family have been identified. Studies have shown that poly (ADP-ribose) polymerase-1 (PARP-1) plays a role in DNA repair, cell division, differentiation, transcriptional regulation, and chromosome stabilization. PARP-1 is involved in the repair of both single- and double-strand DNA breaks. It is a zinc-finger DNA-binding enzyme that is activated upon binding to DNA breaks. When DNA damage occurs, PARP-1 is activated. Overactivation of PARP-1 depletes NAD+, its cellular substrate, and triggers its replenishment. The excessive consumption of ATP during this process leads to

energy loss and cell death. Inhibition of PARP-1 prevents the repair of DNA breaks, leading the cell towards apoptosis. Thus, inhibition of the PARP enzyme has become a target for anticancer drug development. The zinc-finger motifs within the enzyme are crucial for PARP-1 to recognize the damaged DNA regions. Previous studies have shown that the nicotinamide structure inhibits the PARP-1 enzyme. In this study, two new nicotinamide-based benzoic acid derivative compounds were synthesized. The compounds were characterized using spectral methods (IR-ATR, NMR, and LC/QTOF-MS). These compounds were also optimized using computational chemistry methods, and their spectral and electronic properties were investigated. The results obtained were compared and interpreted alongside experimental findings. Finally, the potential of these compounds as PARP inhibitors was explored through in silico methods, including molecular docking, ADME analysis, cytochrome P450 analysis, and MM-GBSA analysis. According to in silico analyses, synthesized compounds are found as active against PARP.

PROMISED ANTICANCER COMPOUNDS BASED ON VITAMIN B6

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Schiff bases, also called azomethines, rank among the most essential synthons in organic chemistry. These compounds attract significant attention from chemists due to their broad synthetic and biological applications. Studies have confirmed that Schiff bases exhibit remarkable properties, including antibacterial, antiviral, antifungal, anti-HIV, antidiabetic, and anticancer activities.

Pyridine derivatives are extensively utilised in clinical settings, serving as antioxidants, antivirals, antimicrobials, antidiabetics, antimalarials, antitubercular agents, psychopharmacological antagonists, antiproliferatives, and anti-inflammatory agents. Their biological relevance stems from attributes such as water solubility, chemical stability, hydrogen bonding ability, and small molecular size. Vitamin B6 is crucial for the metabolism of amino acids, carbohydrates, and lipids, with its active form, pyridoxal, facilitating important enzymatic processes. Additionally, it has a significant role in cancer biology, especially in breast cancer, which accounts

for 11.6% of cancer-related deaths worldwide. Schiff bases have shown promise as potential antitumor agents by suppressing the growth of cancer cells.

Natural pyridine-containing compounds include niacin, vitamin B6, nicotinamide adenine dinucleotide, and trigonelline. Furthermore, pyridoxal, a derivative of vitamin B6, plays a critical role in metabolic functions like deamination, transamination, decarboxylation, and the metabolism of amino acids, sugars, and fats.

Building on these insights, novel azomethines were synthesised using vitamin B6 and an aliphatic polyamine. Pyridoxal hydrochloride was the aldehyde component, while pentaethylenehexamine acted as the amine. The structures of these Schiff bases were confirmed through 1H and 13C NMR spectroscopy, mass spectrometry, and elemental analysis.

Acknowledgement: This work was supported by the Science Development Foundation under the President of the Republic of Azerbaijan – Grant № AEF-GAT-7-2023-2(44)-10/08/4-M-08.

ACTIVITY OF PYRROLIDINEBENZENESULFONAMIDES DERIVATIVES AGAINST CARBONIC ANHYDRASE AND ACETYLCHOLINESTERASE

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Pyrrolidine benzene sulfonamides are compounds of pharmacological importance due to their high reactivity and multifunctional properties in their chemical structures. The potential of these compounds to inhibit carbonic anhydrase (CA) enzymes constitutes an important area, especially in the treatment of glaucoma and other CA-dependent diseases. The structural compatibility of the pyrrolidine and benzenesulfonamide groups allows these compounds to exhibit selective binding to CA isoenzymes and strong inhibitory activity. The sulfonamide group generally provides inhibition by directly interacting with the zinc ion in the active site of CA enzymes. This means that these compounds suppress enzyme activity both effectively and selectively.

On the other hand, the potential inhibitory effect of pyrrolidinebenzenesulfonamides against acetylcholinesterase (AChE) enzymes is promising for the treatment of neurodegenerative diseases such as Alzheimer's disease. It is thought that these compounds prevent the hydrolysis of acetylcholine by interacting with the catalytic triad in the active site of AChE. AChE inhibition may improve

neurotransmission by increasing acetylcholine levels in the synaptic cleft. Molecular docking and in silico studies show that pyrrolidinebenzenesulfonamides have strong binding energies and favorable interaction profiles with both AChE and CA enzymes. Such dual-action inhibitors offer significant potential for multitarget drug design.

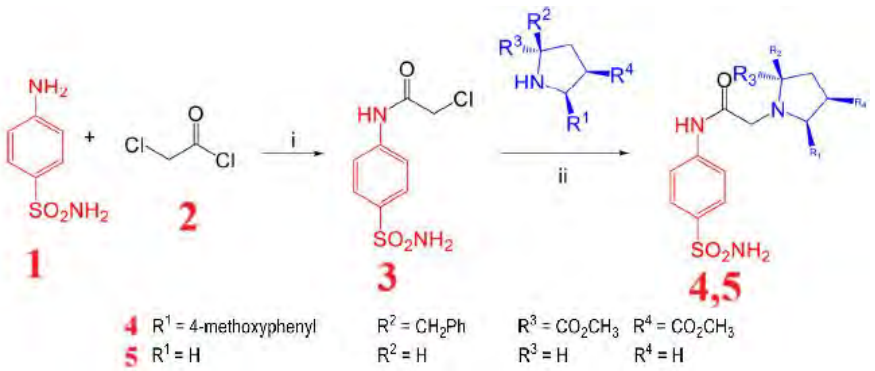

Figure 1. molecular structure of molecule 4 and 5

Pyrrolidinebenzenesulfonamides derivatives 4 and 5 molecules were synthesized from the above reaction and obtained in figure 1. Afterwards, optimized structures of molecule 4 and 5 were obtained using various programs, these programs are Gaussian09 RevD.01 and GaussView 6.0. By using these programs, calculations were made in B3LYP, HF, and M06-2X methods with the 6-31++g(d,p) basis set. Finally, the activities of compounds 4 and 5 against carbonic anhydrase protein and acetylcholinesterase proteins were investigated by molecular docking calculations. These compounds were found as active against these proteins.

STUDY OF RHODAMINE 6G AND ACRIDINE YELLOW CATIONIC DYES ADSORPTION FROM AQUEOUS SOLUTIONS ONTO HYBRID COMPOSITES USING THREE-PARAMETER ISOTHERM MODELS

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The removal of dyes from wastewater is a critical environmental challenge due to their toxic effects and persistence in aquatic ecosystems. This study focuses on

the adsorption of two cationic dyes, Rhodamine 6G (Rh6G) and Acridine Yellow (AY), onto hybrid composite materials, including a phosphorus-containing composite and graphene-based adsorbents.

The phosphorus-containing composite, synthesized using polybutadiene rubber (PBR) and bentonite through oxidative chlorophosphorylation, showed excellent adsorption efficiency for Rh6G. The adsorption equilibrium data were analyzed using three-parameter isotherm models (Sips, Redlich-Peterson, Toth, and Khan) and four-parameter models (Fritz-Schlunder, Baudu, and Marczewski-Jaroniec). Among these, the Toth model provided the best fit, with the highest R^2 value and lowest error metrics, effectively accounting for surface heterogeneity.

For AY, adsorption experiments were conducted using graphite, graphene nanoplates, and a graphene-based composite. Graphene nanoplates, synthesized via oxidative chlorophosphorylation, exhibited a significantly higher adsorption capacity (7.25 mg/g) compared to graphite (5.42 mg/g). The adsorption behavior was successfully modeled using the Sips and Khan isotherms. The superior performance of graphene nanoplates is attributed to their unique structural properties, particularly their reduced layer count (~40 layers compared to ~110 layers for graphite), which offers more active adsorption sites and enhances π-π interactions with dye molecules.

The study also investigated AY adsorption onto the graphene-based composite, synthesized via oxidative chlorophosphorylation, using three- and four-parameter isotherm models. The results confirmed that three-parameter models, such as Sips and Khan, provided a more accurate representation of the experimental data compared to four-parameter models.

Overall, this study underscores the effectiveness of advanced adsorbent materials for dye removal and highlights the utility of three-parameter isotherm models in understanding adsorption mechanisms.

SYNTHESIS OF DIARYLUREA DERIVATIVES AND INVESTIGATION OF THEIR IN SILICO ACTIVITY AGAINST INSULIN-LIKE GROWTH FACTOR (IGF)

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Cancer is a serious disease characterized by uncontrolled cell growth. Types such as breast, lung, prostate, and colorectal cancer are among the most commonly diagnosed. In this regard, scientific research is focused on understanding the molecular mechanisms of cancer and developing targeted therapeutic strategies. In this study, the synthesis of a diarylurea derivative compound was achieved, and their biological activity against target proteins, particularly insulin-like growth factor (IGF), estrogen receptor (ER), and HER2, were evaluated using in silico methods. These compounds, with potential therapeutic applications, aim to modulate cellular growth and slow cancer progression, especially in prevalent and fatal cancers like breast cancer. The compound, 1-(3-acetylphenyl)-3-(3-chlorophenyl) urea, was designed based on the efficacy of similar diarylurea derivatives reported in the literature for cancer treatment. The structural optimization of the molecule was performed using GaussView and Gaussian16 software, with its geometry and IR spectrum thoroughly analyzed. During the synthesis process, 3'-aminoacetophenone and 4'-chloroisocyanate were reacted in a toluene medium to obtain the target compound, which was subsequently purified. The structural characterization of the compound was validated using NMR, IR, and LC-QTOF-MS spectroscopic techniques. The binding efficiency of the synthesized compound to the biological target proteins was analyzed through molecular docking methods. These analyses, conducted using Schrödinger Maestro software, revealed that the compound exhibited high binding energy and stable interactions with the HER2 protein. Additionally, notable activity was observed against IGF and ER proteins. The binding energy results demonstrated the potential of the compound as a strong inhibitor of HER2. Furthermore, the pharmacokinetic properties of the compound were assessed through ADME analysis, confirming its suitability for therapeutic use with all parameters falling within acceptable ranges. The compound exhibited favorable bioavailability and absorption characteristics. However, its interaction with the CYP2C9 enzyme suggests the necessity of dose adjustments during clinical application. In conclusion, this study indicates that the synthesized diarylurea derivative holds significant promise for the treatment of estrogen-dependent cancers, such as breast cancer. The findings have been presented at an international congress and are expected to provide a foundation for the development of next-generation anticancer agents.

Acknowledgment: We would like to thank The Scientific and Technological Research Council of Türkiye (TÜBİTAK) for the financial support under the project number 1919B012204976.

SYNTHESIS AND INVESTIGATION OF FULLERENE AND GRAPHENE OXIDE DOPED ZNAL-LDH/PVS NANOCOMPOSITES FOR PHOTOCATALYTIC APPLICATIONS

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Carbon materials including activated carbon (AC), activated carbon fibers (ACF), bio-carbon (BC), carbon nanotubes (CNT), fullerene, graphene, graphene oxide (GO), etc. are widely used and studied in recent years. Currently, the known carbon materials and layered double hydroxide (LDH) based composites are promising materials for potential applications in light absorption, sorption, electricity, magnetism, supercapacitors, catalysis, etc.

Carbon based or doped nanocomposites could simultaneously remove both organic pollutants and metal ions with their high surface areas and functional properties. Graphene oxide (GO) is an oxidized form of graphene, which is distinguished by its unique structural properties and large surface area. The surface of this material is rich in various functional groups (hydroxyl, epoxy and carboxyl) and more suitable for interaction with pollutant ions and molecules.

In the presented work, the Hummers method was used in the synthesis of GO. The obtained GO and commercial fullerene solutions are added to the ZnAl-LDH/PVA composite by a simple impregnation method. The percentage of carbon materials in LDH/polymer composites is 50%, 25%, 12.5% and 5% for GO and 60, 20, 10 and 1% for fullerene. The optical absorption coefficient of the samples is measured by ultraviolet-visible spectroscopy. According to the obtained results, the band gap of the LDH samples with 50%, 25%, 12.5% and 5% of GO dopants are 3.31 eV, 3.28 eV, 3.22 eV and 3.67 eV, respectively.

The average size of nanocrystallites increased from 8 nm to ~20 nm and the dislocation density (δ) decreased from 0.0127 nm^2 to ~0.003 nm^2 by non-covalent doping of fullerene (C_{60}) molecules to ZnAl-LIH/PVS nanocomposites. With the doping of a high amount of C_{60} into the nanocomposite, the active centers on the surface of the LDHs were covered, as a result the ionic conductivity of ZnAl-LDH decreased.

The photodegradation of Methylene blue and Congo red on fullerene-doped ZnAl-LDH/PVA nanocomposite was mediated by $^{\cdot}O_2^-$ anion radicals and $^{\cdot}OH$ radicals, respectively. Although all known active species were generated on the surface of the photocatalyst, it was found that the nature of the dye molecules also affected which active species was mainly responsible for the photodegradation.

EVALUATION OF BORON AND MAGNESIUM CO-DOPED SIO_2–CAO–NA_2O–P_2O_5, B_2O_3-MGO NOVEL BIOACTIVE GLASS COMPOSITION

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Bioactive glasses (BGs) are inorganic structures that interact with body tissues and release calcium and phosphate ions when in contact with aqueous solutions instead of being inert. These structures, which are surface reactive biomaterials, can be firmly bonded to soft/hard tissues by allowing the formation of an inorganic layer by their bioactivity; they can support bone, periodontal and skin regeneration. From many years, a wide variety of elements are doped in their composition to enhance the physical and therapeutic effects of traditional BGs.

In this study, it was aimed to investigate the synergetic effect of boron (B) and magnesium (Mg) ions by co-doping of these ions to the main bioactive glass structure with SiO_2-CaO-Na_2O-P_2O_5 composition. The co-doped and undoped BGs were produced by sol-gel method; elemental compositions, chemical structures and thermal behaviors were determined by XRF, FTIR and TG-DTA analyses, respectively. *In vitro* bioactivity properties of the BGs were determined by incubating them in simulated body fluid (SBF) for 7, 21 and 28 days. Accordingly, ion emission behaviors were analyzed by ICP-OES, so ion concentrations in SBF were determined. The hydroxyapatite formation was investigated by SEM-EDS, XRF and FTIR analyses regarding bioactivity. Furthermore, MTT test was used to observe *in vitro* cytotoxicity of the BGs.

As a result of the studies, it is observed that the incorporation of ions to the BG composition affected the thermal behavior. After incubation in YVS, faster Ca^{+2} ion release was determined from the co-doped BG, especially in first days. In addition, calcium phosphate layers, which are indicative of bioactivity, were observed on the co-doped surface of BG, which means that the novel BG shows good bioactivity. The

BG didn't show a toxic effect on L929 mouse fibroblast cells; but showed a decreased cell proliferation while increase in BG concentration. Consequently, this study has shown that B and Mg co-doped BGs can be used in the field of tissue engineering with their well bioactivity and toxicity.

Acknowledgement: This work has been supported by Health Institutes of Türkiye under project number 24239.

ENRICHMENT OF SLIGHTLY OIL-POLLUTED SOILS WITH ORGANIC FERTILIZERS

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The learn of our research was to study the effect of enriching soils with a moderate degree of oil pollution (2%) by adding dry cotton leaves and bentonite suspension (montmorillonite).

The proposed enrichment method requires careful grinding of dry cotton leaves in order to prevent the process of rotting, increase growth and strengthen the roots of wheat. Also, the bentonite used was pre-dispersed in order to enrich the soil with mineral additives and increase its fertility, while a colloidal suspension or gel is formed.

We first introduced the prepared organic fertilizer into ordinary soil and studied the efficiency of wheat plant growth. The properties of bentonite, such as hydration, swelling, water absorption, viscosity, make it a valuable material for a wide range of applications. The formed tiny particles of bentonite contribute to a more uniform distribution of macro and microelements in the used volume of soil.

The crushed bentonite powder was mixed with water and subjected to ultrasonic treatment at a frequency of 20 kHz in an Ultrasonic Cell Crusher Noise Isolating Chamber, which produced bentonite particles of 20 nm in size.

As experimental data have shown, the use of dry cotton leaves as an organic fertilizer at a rate of 80.5-90 kg/ha, and as a mineral additive a dispersed suspension of bentonite in an amount of 40-50 kg/ha will enrich the soil and ensure more intensive growth of grain crops.

DRUG RESISTANCE IN CANCER

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Chemotherapy is the most widely used treatment strategy for cancer, which is the second reason for human deaths after heart-related diseases. However, cellular resistance mechanisms developed by cancer cells and tissues in the beginning or proceeding times to apply anticancer agents is a significant problem preventing successful therapy. Resistance cancer cells develop to structurally and functionally different cytotoxic agents is called multi-drug resistance.

Drug resistance mechanisms have different molecular genetics and biochemical reasons depending on the applied drug and the type of cancer. Secondary genetic alterations and disorders in cancer cells may also result in drug resistance. That is why it is vital to study and consider all signaling pathways in multidrug resistance of cancer.

Multidrug resistance occurs via many unrelated mechanisms, such as overexpression of energy-dependent efflux proteins, decrease in uptake of the agents, increase or alteration in drug targets, alterations in cell cycle checkpoints, inactivation of the agents, compartmentalization of the agents, inhibition of apoptosis, increases in DNA repair mechanisms, problems related with drug metabolism and aberrant metabolism of bioactive sphingolipids. Exact elucidation of resistance mechanisms and molecular and biochemical approaches to overcome multidrug resistance have been a significant goal in cancer research. In this talk, I will explain the mechanisms contributing to multidrug resistance in cancer chemotherapy and touch on the approaches for reversing the resistance.

IMPACT OF Fe_3O_4 NANOPARTICLES ON BIOACCUMULATION, TISSUE STRUCTURE AND REPRODUCTION IN COMMON CARP (*CYPRINUS CARPIO* LINNAEUS, 1758)

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The widespread application of Fe_3O_4 nanoparticles (20–30 nm) in various industries, including aquaculture, necessitates a thorough understanding of their effects on aquatic organisms. This study investigates the bioaccumulation, ultrastructural changes, and impacts of these nanoparticles on common carp (Cyprinus carpio Linnaeus, 1758) under aquaculture conditions. The research focuses on both structural changes in intestinal and liver tissues and the reproductive development of the fish. (Agayeva N.J.; Rzayev F.H.; Gasimov E.K.; Mamedov Ch.A.; Ahmadov İ.S.; Sadigova N.A.; Khusro A.; Al-Dhabi N.A.; Arasu M.V. (2020), Exposure of rainbow trout (*Oncorhynchus mykiss*) to magnetite (Fe3O4) nanoparticles in simplified food chain: Study on ultra-structural characterization).

Fish were exposed to Fe_3O_4 nanoparticles through feed and reproductive cells in various doses (ranging from 10 mg to 100 mg per 10 g of feed and up to 0.05 g for reproductive exposure). Light and electron microscopic studies revealed that nanoparticles sequentially penetrate the microvilli of intestinal enterocytes, accumulate in cytoplasmic organelles, and are transported to the liver and other tissues. While low doses caused mild disruptions in intestinal villi and hepatic structures, higher doses led to severe damage, including the destruction of hepatocytes, bile ducts, and blood vessel walls. (A.D. Hajiyeva, Ch.A. Mamedov, R.I. Khalilov (2022), Influence of nanoparticles on the yield of embryos of the roe common carp (Cyprinus carpio Linnaeus, 1758) ın the fermentation process)

In reproductive cells, Fe_3O_4 nanoparticles were observed to enhance sperm activity and fertilization rates at optimal concentrations (0.05 g), significantly increasing the yield of viable embryos. However, excessive nanoparticle exposure resulted in increased embryonic mortality and structural abnormalities during development. (Ahmadov I.S., Ramazanov M.A., Gasimov E.K., Rzayev F.H., Veliyeva S.B. (2020) The Migration Study of Nanoparticles from Soil to the Leaves of Plants)

The study highlights the dual role of Fe_3O_4 nanoparticles: at low concentrations, they demonstrate catalytic effects that enhance reproductive efficiency and productivity in aquaculture. However, at higher doses, they pose significant risks to fish health and embryonic development. These findings emphasize the need for controlled and responsible nanoparticle use in aquaculture systems to maximize benefits while minimizing potential risks.

Acknowledgement: This work was supported by the Azerbaijan Science Foundation-Grant № AEF-MGC-2024-2(50)-16/09/3-M-09.

MESENCHYMAL STEM CELLS REDUCE SUSTAINED MICROGLIAL PROLIFERATION AND BRAIN INFLAMMATORY RESPONSE

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The activation of microglial cells is responsible for the chronic inflammation seen in the brain tissue during many neurodegenerative disorders. Even though the major function of microglial cells in the healthy brain is to survey the surrounding neural tissue, they are also highly reactive cells whose activation causes an excess of neurotoxic cytokines and pro-inflammatory mediators. In the present research, we tested the efficacy of intravenously injected umbilical cord-derived MSCs on animal models of peripherally induced chronic neuroinflammation.

Experimental mice were divided into three groups: control naïve, LPS-injected vehicle-treated, and LPS-injected MSC-treated animals. Systemic inflammation has been created by intraperitoneal injection of lipopolysaccharide (Escherichia coli serotype: 055:B5; Sigma–Aldrich, St. Louis, MO, USA) at a dose of 5mg/kg. On the next day umbilical cord MSCs were injected intravenously into the third animal group. The brains of mice were examined a week after the LPS injection employing immunohistochemistry for evaluation of microglial cell activation. A dual immunofluorescence method was employed for visualizing microglia expressing both IBA-1 (a marker of all microglia) and ED-1 (CD68, a marker of activated microglia) in different regions of the hippocampus. ELISA methods have been used to evaluate the concentration of proinflammatory cytokines TNFa, IL-1β, IL-6, and IL-18 in mice hippocampi.

A week after the LPS injections immunohistochemistry revealed that the density and morphology of microglia varied between groups in different brain regions. Compared to naive mice, numbers of IBA-1+ microglia significantly increased in the CA1 and CA3 subfields, the entire hippocampus, as well as prefrontal cortex of the vehicle-treated LPS mice ($p<0.05$). However, treatment with the MSCs led to a considerably reduced amount of IBA-1+ microglia and approximate the control group in all investigated areas of the hippocampi and prefrontal cortex areas of LPS-injected mice. Compared to the naïve control group, the LPS+Veh group displayed increased percentages of IBA-1+ microglia with ED-1+ structures (i.e., activated microglia) in all subfields of the hippocampus, the entire hippocampus, and frontal cortex areas, implying the presence of long lasting neuroinflammation in the

mentioned brain areas (p<0.05 – 0.0001). MSC treatment, however demonstrated positive outcome by reducing the extend of inflammatory changes in microglial cells, which was apparent from the statistical analysis of the results obtained from the quantification of IBA1-ED1 structures throughout the hippocampus and frontal cortex regions. Biochemistry analysis of tissue homogenates revealed that compared to naive mice, the concentrations of proinflammatory cytokines IL-1β, TNFα, and IL-18 were elevated in the vehicle-treated LPS mice compared to control mice (p<0.05-0.01), and diminished in the MSC-treated LPS mice (p<0.05-0.001).

MSC treatment at early stages can restrain the proliferation and activation of microglia and reduce brain inflammation.

THE ROLE OF MEDICINALLY SIGNIFICANT TOXIC PLANTS IN STRENGTHENING THE IMMUNE SYSTEM AGAINST VIRUSES DURING PANDEMICS

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From ancient times, medicinal plants have been widely used in combating pandemics, both in traditional and official medicine. Prioritizing human health, providing medical care, and ensuring access to essential medications have always been of paramount importance. In this context, toxic plants with active compounds hold a special place. While these compounds are toxic in high doses, they are used to produce medicines in lower doses. In medicine, 40% of pharmaceutical preparations are derived from toxic plants.

In modern times, providing society with access to all essential medications has become a vital necessity. Plants have always been the primary raw material source for producing medicinal preparations. Among the 150 medicinal plants utilized in scientific medicine, the majority are toxic plants. In Azerbaijani flora, plants rich in such compounds include representatives of the Ranunculaceae and Solanaceae families. Medicinally significant representatives from these families, such as *Adonis vernalis* L., *Atropa caucasica* Kreyer, and *Hyoscyamus niger* L., are used to treat various diseases.

Adonis vernalis is used for heart diseases (heart failure, cardiac neurosis, obesity of the heart, Basedow's disease). It dilates coronary arteries, provides pain relief, and acts as a diuretic. *Atropa caucasica* preparations are used for stomach and

duodenal ulcers, chronic hyperacid gastritis, kidney pain, and more. Its dried leaves are also used in anti-asthma cigarette production. *Hyoscyamus niger* is highly toxic, and its preparations should only be used under a doctor's supervision. Its leaves are part of the "Astmatol" complex anti-asthma preparations.

Additionally, medicinally significant toxic plants from the Zygophyllaceae family, such as *Peganum harmala* L., play a multifaceted role in medicine. The seeds of this plant are particularly used medicinally, containing 3-4% alkaloids, 30% of which consist of harmine. The harmine-hydrochloride preparation derived from *Peganum harmala* seeds is used to treat nervous disorders such as endemic encephalitis and Parkinson's disease. As these preparations are toxic, they are stored in the "A" list of pharmacies.

Currently, many valuable toxic medicinal plants are cultivated in various regions of our republic (Shaki, Gakh, Zagatala, Balakan, Masalli, Lankaran, Astara, Absheron). These plants play a special role in medicine. The use of such medicinal plants is crucial in strengthening the immune system against viruses during pandemics and treating various diseases. In modern times, significant reserves of medicinal plants have been established. During global disease outbreaks, epidemics, and pandemics, there is a particular need for medicinal plants to enable natural treatment. Therefore, preserving and protecting plants, especially medicinal ones, and increasing their reserves remain critical and pressing issues.

ETHNOBOTANICAL STUDY OF THE VILLAGE OF BAKIKHANOV (BAKU, AZERBAIJAN REPUBLIC)

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The origin of the word "ethnobotany" comes from two words "ethno" - the study of people and "botany" - the study of plants, i.e. it is a science that studies the interaction of people with plants. For pharmaceutical scientists, ethnobotanical research is the most important aspect in the field of identifying new medicinal plants in order to expand the arsenal of herbal preparations. But ethnobotany as a whole is an interdisciplinary science that is on the border of natural and humanitarian sciences and studies the use of plants in all spheres of human activity. The purpose of our research was to identify the range of useful plants used by the population of the Bakikhanov settlement of the city of Baku through a survey.

Bakikhanov Settlement (40°25′08″ N, 49°57′52″ E), named after the Azerbaijani scholar and writer Abbasgulu Agha Bakikhanov, is an urban-type settlement and the administrative center of the Sabunchu district. It was founded on May 1, 1923, as the first workers' settlement of Azneft, built in oil production areas. Until 1992, the settlement was named after Stepan Razin, a Don Cossack who led a major rebellion from 1667 to 1671, and whose detachment had once camped near a small hill with numerous caves in this location. The population of the settlement was 71,600 people as of 2013.

Before conducting the survey, extensive scientific literature was reviewed to identify optimal methods suitable for our research conditions. Relevant questionnaires were designed, taking into account the respondents' ethnicity, residence, age, education, and occupation. The questionnaire included questions related to the use, acquisition, and storage of useful plants, along with their categorization by usage (medicinal, food, aromatic, fodder, technical, ornamental, etc.). The results were statistically processed using SPSS software.

The research was conducted from November 2022 to February 2023, primarily among people aged 30 and older. As a result, information was collected from over 250 respondents regarding more than 180 plant species most familiar to the local population. Scientific names, family classifications, habitat conditions, raw material harvesting methods, and usage categories of these plants were clarified. Data analysis revealed several interesting patterns linked to the respondents' demographic characteristics. For example, the data showed variations based on ethnicity and age. Indigenous residents of the settlement showed a greater preference for medicinal and food plants. A notable interest in plant use was observed among individuals aged 50 and above.

The distribution of useful plants across various areas of application in the daily life of the population of Bakikhanov is as follows: food plants—34%, ornamental—19%, medicinal—18%, dye plants—12%, aromatic—10%, fodder—5%, technical—1%, and other uses—1%.

THE STUDY OF QUERCETIN GLYCOSIDES AND ITS DERIVATIVES' EFFECTS ON ANGIOTENSIN-CONVERTING ENZYME THROUGH MOLECULAR DOCKING AND IN SILICO ANALYSIS

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Cardiovascular diseases (CVDs), mainly caused by hypertension and imbalances in the renin-angiotensin-aldosterone system (RAAS), are among the leading causes of death worldwide (Patel et al., 2017). RAAS plays a crucial role in regulating blood pressure and maintaining cardiovascular stability, with angiotensin-converting enzyme I (ACE I) being central to its function. ACE converts angiotensin I into the vasoconstrictor angiotensin II while breaking down vasodilators like bradykinin. Inhibiting ACE effectively controls hypertension, CVD, and kidney disease by lowering angiotensin II levels, promoting vasodilation, and reducing the heart's workload.

Although synthetic ACE inhibitors (ACEIs), such as enalapril and lisinopril, are commonly prescribed, they often lead to side effects like hyperkalemia, angioedema, and taste disturbances. These adverse effects have prompted interest in plant-based ACE inhibitors as safer, non-toxic alternatives. Quercetin, a flavonoid antioxidant found in foods such as onions, berries, and red grapes, is particularly promising due to its ability to reduce oxidative stress and prevent diseases like CVD, cancer, and osteoporosis. Quercetin glycosides—quercetin molecules bonded with sugar units—offer enhanced bioavailability and absorption, making them ideal candidates for therapeutic use.

This study explores the molecular basis of ACE I inhibition by 12 quercetin glycosides through molecular docking and dynamic simulations, utilizing Chimera, AutoDock Vina, Open Babel, and Discovery Studio Visualizer software. Both the C- and N-domains of ACE I were targeted, with binding interactions analyzed in detail. Among the tested glycosides, quercetin 3-O-arabinoside, quercetin 7-O-glucoside, quercetin 3-O-galactoside, and quercetin 5-glucoside exhibited the highest binding affinities, ranging from -9.1 to -9.9 kcal/mol. These compounds established stable interactions within the ACE active site, forming hydrogen bonds and metal-acceptor interactions with the critical catalytic residue Zn701. Additional stabilization was achieved through Van der Waals forces and various Pi interactions—including Pi-Pi T-shaped, Pi-Pi stacked, Pi-cation, Pi-sigma, and Pi-alkyl interactions—with

key amino acid residues. The observed binding patterns align with previously reported studies involving other ACE inhibitors, further corroborating the potent inhibitory properties of quercetin glycosides.

Given the central role of RAAS in various pathophysiological conditions and the therapeutic promise of quercetin glycosides as natural ACE inhibitors, this research highlights opportunities for developing more effective and safer treatments. Future efforts could focus on structural modifications of these glycosides and experimental validation in preclinical and clinical settings to translate these findings into tangible health benefits.

EFFECTS OF Fe_3O_4 NANOPARTICLES ON THE LIVER OF BIRDS. LIGHT AND ELECTRON MICROSCOPIC STUDY

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The size of nanoparticles compatible with proteins and polynucleic acids makes it possible to use them in biology and medicine. Structures with targeted delivery function made on the basis of nanoparticles of metal oxides have antibacterial, antiviral and anthelmintic properties. It is also important to consider that certain nanoparticles are toxic and can cause various pathologies in the host's body, including the liver. Given these considerations, the purpose of study is the bioaccumulation and pathologies caused by Fe_3O_4 nanoparticles in the liver of geese infected with parasites *in vivo* using light and electron microscopy.

Chemically synthesized Fe_3O_4 nanoparticles were administered to each of the domestic geese (6 units) at a concentration of 100 μg/ml *in vivo*, and after 3 days, the samples obtained from the birds' livers were dissected and fixed in a special solution. Livers from an additional six geese used as the control group. Araldite-Epon blocks were prepared from the material based on the established general protocols in electron microscopy. Semi-thin (1-2 μm) sections were obtained from the blocks using an EM UC7 (Leica) ultramicrotome were viewed under a Primo Star (Zeiss) microscope and photographed with an EOS D650 (Canon) digital camera. Ultrathin sections were studied under a JEM-1400 transmission electron microscope (TEM) under a voltage of 80-120 kV and electrograms were recorded.

During the TEM study of the nanoparticles used in the experiments, it was determined that their free state size was 8.04-17.95 nm (11.90±0.41 nm). When domestic geese were exposed to Fe_3O_4 nanoparticles *in vivo*, it was visually revealed that they bioaccumulated in various structural components of the hosts' livers (erythrocytes in the lumen of vessels, cytoplasm of endothelium, cytoplasm and various organelles of hepatocytes, wall and lumen of bile capillaries). The size of nanoparticles in the liver tissue of birds was 10-11 nm. No pathology was observed in the structural elements of the liver of birds in the control group. During the examination of the liver through a light microscope, after the effect of nanoparticles, the boundaries between hepatocytes were not distinguished, and amorphous transparent areas were formed in their cytoplasm. A large number of fat droplets in the cytoplasm of hepatocytes can be seen as a sign of steatosis. Blood stasis was detected in the lumen of blood vessels. In the liver studied at the ultrastructural level by TEM, it was found that the membranes of fat droplets in the cytoplasm of hepatocytes were damaged, and some of them fragmented. Cristae of some mitochondria were not observed. Inside the hepatocyte nucleus, chromatin was unevenly distributed. Liver cell membranes were damaged. The increased permeability of blood vessels in the liver was observed. Fragments of endothelial structural elements were observed to migrate toward the vessel lumen. The membranes of the microvilles directed to the lumen of the bile capillaries were not clearly visible in electronograms. Obtained results show that Fe_3O_4 nanoparticles used in experiments (100 μg/ml) can induce varying degrees of pathology in the liver of geese.

EFFECT OF IAA ON NO AND PEROXIDASE LEVEL IN AGDASH-3 (*GOSSYPIUM HIRSUTUM) COTTON UNDER DROUGHT STRESS*

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As a result of environmental changes and decreasing of useful water sources, cotton (Gossypium hirsutum) plantation face drought problem. Drought causes to stress in plants and impacts physiological, biochemical and morphological parameters

When plants are under stress, those fit themselves to environment with physiological, biochemical changes. Several enzymatic changes help to adaptation of plants, NO and peroxidases include to biochemicals lists which regulates plants to

stress condition. NO play roles alleviating toxic effects which caused by stressors, regulates ROS (reactive oxygen molecules) level by inducing transcriptional changes. ROS regulates some essential processes like pathogen defence, programmed cell death, while in small amount of ROS help to stress adaptation, while in high amount can cause cellular damages. Peroxidases also play physiological regulator and to response abiotic and biotic stress factors and biosynthesis of lignin.

Phytohormones are other type plant biochemical parameters which play crucial roles in adjustment of physiological parameters and plant development. As other phytohormones, Indol acetic acid plays special roles in plants as well. IAA is considered natural auxin and regulates cell division, plant growth by regulating of number of lateral roots and its branching. Exogenous application of IAA stimulates endogenous IAA amount and its function in plants. Peroxidase can degrade IAA while NO enhance IAA level.

Our study learning applying of 10 μM IAA and 50 μM IAA to Agdash-3 (Gossypium hirsutum) cotton under drought stress and measurements on NO and peroxidase level. Our results show that 5%PEG (drought stress) reach NO level to maximum while control and 10 μM IAA plants show minimum results. 10 μM IAA + PEG and 50 μM IAA+ PEG combinations results are lower than 50 μM IAA results while higher than control and 10 μM IAA cotton. Peroxidase level is maximum in 50 μM IAA while minimum results shows in 10 μM IAA. Peroxidase level in control 5%PEG plants is higher 10 μM IAA + PEG and 50 μM IAA+ PEG combinations while control plants result is lower than 5%PEG plants. These results suggest that Peroxidase and NO levels are so high in drought stress. 50 μM IAA increase those level to high while other combination shows lower results than control plants.

STUDY OF ANTIBACTERIAL PROPERTIES OF ESSENTIAL OIL OBTAINED FROM THE LEAVES OF SAVORY (SATUREJA HORTENSIS L.)

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Due to the absence of new effective drugs, the treatment of patients in cases of infection with multidrug-resistant bacteria is extremely difficult. In this regard, an important justification for the special commission of the Infectious Diseases Society of America (IDSA) to study the issue of accessibility of antimicrobial drugs to include resistant pathogens such as *Staphylococcus aureus*, *Pseudomonas

aeruginosa*, *Acinetobacter sp.*, *Klebsiella pneumoniae* in the list of "problematic" bacteria with a growing level of resistance to almost all groups of antibiotics was the need to develop new antimicrobial agents against them. In the framework of addressing the issue of antibiotic resistance, the search for alternative means is relevant. Among them are plant-based essential oils. However, a detailed study of the antimicrobial action of essential oils against the so-called "problematic" bacteria has so far been insufficiently explored.

Among the rich flora of Azerbaijan, due to its popularity in scientific and alternative medicine, wide distribution, and unpretentiousness in cultivation, special interest for study is presented by the essential oil plant summer savory (*Satureja hortensis L.*) of the family Lamiaceae. In medicine, this plant is used as an expectorant, antibacterial, diuretic, antifungal agent, and is part of the means intended for the treatment of upper respiratory tract diseases and digestive disorders. In our country, under the name " herba cibum," it is used in cooking as a seasoning for meat.

The aim of our study was to obtain essential oil from the leaves of summer savory, collected during the period of mass flowering of the plant in July 2023 in the Shahbuz region of the Nakhchivan AR on dry rocky and stony slopes (39°21'44.27"N, 45°40'18.07"E, alt. 1592 m), and to determine antibacterial activity on resistant strains of "problematic" bacteria.

Methods of study: For obtaining essential oil, the method of steam distillation was used. The antibacterial action of the essential oil was studied using the disk-diffusion method. The antimicrobial effect of the essential oil of *Satureja hortensis L.* was compared with Vaseline and 96% ethyl alcohol.

Results: The content of essential oil in our raw material was 2.6%. The color of the obtained essential oil was light yellow. The essential oil showed various antimicrobial effects against both reference and resistant strains (*Klebsiella*, *Escherichia*, *Proteus*, *Staphylococcus*, *Streptococcus*, *Pseudomonas*, *Enterococcus*, *Salmonella*, *Enterobacter*, *Citrobacter*, and *Acinetobacter*) due to its rich component composition, dominated by thymol (37.61%), γ-terpinene (21.47%), and p-cymene (12.31%).

The essential oil obtained from *Satureja hortensis L.* growing in Azerbaijan has a strong antibacterial effect on both reference and resistant bacterial strains. Among the mentioned bacteria, the weakest action of the essential oil was observed on *Salmonella* bacteria with a growth inhibition zone diameter of 22 mm. The growth inhibition zone for *K. pneumoniae* was 50 mm.

EFFECTS OF ZINC IONS ON LIVING ORGANISM

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Zinc is the second most abundant transition metal in living organisms, essential for 5–10% of proteins in prokaryotes and eukaryotes. Over 50% of zinc-bound proteins are enzymes, where zinc often plays a catalytic role. It also serves as a structural component in some proteins and as a regulator or substrate in others. The critical role of zinc in various biological processes is balanced by specialized systems evolved to maintain zinc homeostasis, preventing toxicity from high concentrations. Zinc plays a key role in enabling bacterial pathogens to cause disease, though it can also be detrimental in certain infections. It has been used for years to treat and prevent diarrheal diseases, especially those caused by E. coli (EPEC). Early on, it was thought that zinc's therapeutic effects were primarily due to boosting the immune response and inhibiting ecto-5'-nucleotidase, an enzyme linked to diarrhea. However, this explanation was found to be incomplete in accounting for the full range of observed therapeutic effects.

High concentrations of zinc ions are toxic to bacterial cells, leading to cell death. In contrast, sublethal levels of zinc can prevent biofilm formation in bacteria such as Actinobacillus pleuropneumoniae, Salmonella typhimurium, Haemophilus parasuis, and, to a lesser degree, E. coli, Staphylococcus aureus, without affecting established biofilms. Zinc oxide nanoparticles which is the most widely used zinc compound for its antibacterial effects can prevent the formation of bacterial biofilms, which are protective layers that bacteria create on surfaces. Since biofilm formation plays a crucial role in bacterial resistance, ZnO helps reduce bacterial adhesion and colonization by inhibiting this process. Zinc oxide nanoparticles are being investigated for applications in infection control, drug delivery, and the treatment of various diseases. Their antibacterial potential is attributed to distinct mechanisms of action that set them apart from traditional antibiotics, which may help reduce the emergence of resistant strains. Studies have shown their effectiveness against a broad spectrum of bacterial species.

The human body holds 2–3 grams of zinc, with about 90% stored in muscles and bones. Notable concentrations are also present in the prostate, liver, gastrointestinal tract, kidneys, skin, lungs, brain, heart, and pancreas. Zinc is absorbed in the small intestine and then transported in the bloodstream, mostly bound to proteins such as albumin, α-microglobulin, and transferrin.

In conclusion, zinc is an essential element with a multifaceted role in both biological systems and human health. It is critical for numerous physiological processes, including enzyme function, protein structure, and regulation, while also being pivotal in bacterial pathogenicity. While crucial for health, its levels must be carefully controlled to avoid toxicity. Zinc oxide nanoparticles have proven effective in preventing bacterial biofilm formation and combatting bacterial resistance. Its potential in treating infections and diseases.

SITE-SELECTIVE N-BOC ACTIVATION OF SECONDARY AMIDE

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In chemistry, a protecting group is a temporary substituent added to a specific functional group in a molecule during complex, multi-step synthesis to prevent unwanted reactions. Once the desired reaction is completed elsewhere in the molecule, the protecting group is removed. Different protecting groups are available for various functional groups, each varying in stability and removal conditions.

Protecting groups are especially vital in the synthesis of compounds with repeating functional groups, such as biomolecules like peptides, oligosaccharides, or nucleotides, where standardized sets are commonly used. Effective protecting groups must meet several criteria: they should attach and detach efficiently under mild conditions, remain stable during other reactions, and produce byproducts that are easy to separate. Additionally, they should be cost-effective and well-documented to ensure reliable use in complex syntheses.

Recently, the activation of amides has emerged as a tool for the chemo-selective synthesis of various biologically relevant molecules *via* *C*(*O*)-*N* bond cleavage. In this context, the transformation of amides into ketones under catalyst-free conditions has received significant interest in organic synthesis. In this context, the transformation of amides into ketones catalyzed by transition metals has received significant interest in organic synthesis. Grignard reagents are powerful aryl donors utilized in many cross-coupling reactions.

While a range of methods to activate the amide bond toward selective Grignard reagents insertion has been developed, by far the most synthetically useful are N-Boc and N,N-diBoc-activated amides allowing direct engagement with common secondary and primary amides in a range of cross-coupling methods after double N-tert-butoxycarbonylation under mild conditions.

Taking into accounts all above-mentioned, we decided to synthesize tert-butyl (3-(4-(3-(4-nitrobenzamido)propoxy)butoxy)propyl)(4-nitrobenzoyl)carbamate before insertion Grignard reagent into amide bond for the synthesis of aryl ketones. The *N*-Boc benzamide was prepared using the general literature prodecure. The synthesis reaction was set up under argon condition at room temperature. The crude product was purified by silica gel column chromatography (SiO2: ethyl acetate/hexane) to obtain the corresponding *N*-Boc benzamide on the one side of amide molecule.

Acknowledgement: This work was supported by the Azerbaijan Science Foundation-Grant No AEF-MCG-2023-1(43)-13/09/3-M-09

COMMUNITY-BASED TOOLS FOR SUSTAINABLE MANAGEMENT OF ETHNOBOTANICALLY RICH FORESTS

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Ethnobotanically valuable forests, rich in biodiversity and cultural heritage, play a critical role in sustaining indigenous and local communities' livelihoods and traditional knowledge systems. However, these ecosystems are increasingly threatened by deforestation, overexploitation, and climate change. This study focuses on developing community-based management tools to ensure the sustainable use and conservation of ethnobotanical resources. A participatory approach was employed,

engaging local stakeholders to co-design strategies that integrate traditional knowledge with modern conservation techniques.

The tools developed comprise a framework for resource mapping, sustainable harvesting guidelines, and forest health monitoring protocols. Additionally, a capacity-building program was implemented to empower local communities in governance and decision-making. This initiative catalogued over 300 plant species, with detailed information on local names, uses, ecological roles, and distribution. Key species such as *Acer campestre* (Hedge maple) and *Allium ursinum* (Wild garlic) demonstrate high versatility, serving roles in food, medicine, dyes, and ecological services like pollination.

Among these, 222 species hold medicinal value, 200 are significant for food, and others support beekeeping, dye production, and oil extraction. Regional mapping highlighted the dominance and rarity of species, offering insights into sustainable harvesting potentials. Automated tools enable local communities and stakeholders, including entrepreneurs, to assess and utilize plant resources responsibly. This research underscores the potential of combining traditional ecological knowledge with modern conservation strategies to promote biodiversity preservation and sustainable livelihoods. Future efforts should enhance participatory frameworks and adapt these tools for global ethnobotanical conservation practices.

SYNTHESIS AND ANTIBACTERIAL POTENTIAL OF SCHIFF BASES CONTAINING B-LACTAM RINGS

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Recent advancements in chemistry have revealed the antimicrobial potential of various compounds and complexes, including Schiff bases. A Schiff base, also known as an imine or azomethine, is a highly significant organic compound that plays a vital role in numerous biological processes. It is derived from aldehydes or ketones, where the carbonyl group (C=O) is substituted by an imine or azomethine group (-C=N-). They are known for their diverse biological activities, including antibacterial, antifungal, anticancer, and herbicidal properties.

Moreover, the incorporation of electron-rich elements such as nitrogen (N), oxygen (O), and sulfur (S) into Schiff base molecules has significantly expanded their range of applications. Heterocyclic frameworks containing azole ring systems and phenol derivatives are associated with diverse biological activities. Additionally, the presence of nucleophilic groups enhances their ability to chelate metal ions, making them highly valuable in areas such as drug development, catalysis, and chromatography.

Compounds with β-lactam rings are widely used as antibiotics due to their simplicity and effectiveness. These compounds have straightforward pharmacological profiles, are often administered parenterally, and generally exhibit short half-lives. The increasing integration of Schiff bases in pharmaceutical chemistry, particularly for targeted drug delivery, highlights the need to synthesize antibacterial compounds containing β-lactam rings for biological applications.

The aim of this study was to synthesize Schiff bases incorporating a β-lactam ring and 3-trifluoromethylbenzaldehyde. While Schiff base synthesis can be performed under varying conditions, this compound synthesized at room temperature and methanol as the solvent. The reaction between the β-lactam ring-containing compound and 3-trifluoromethylbenzaldehyde was carried out with stirring for two hours. Product purity was confirmed through thin-layer chromatography (TLC), and the structures of the synthesized compounds were verified using nuclear magnetic resonance (NMR) spectroscopy.

MOLECULAR DOCKING AND MOLECULAR DYNAMIC SIMULATIONS OF VITAMIN B6 BASED NOVEL COMPOUNDS

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Among the most important synthons in organic chemistry are Schiff bases, also known as azomethines. These compounds are highly appealing to chemists due to their broad biological and synthetic applications. Studies have shown that Schiff

bases possess unique properties, including antibacterial, antiviral, antifungal, anti-HIV, antidiabetic, and anticancer activities.

Pyridine derivatives exhibit diverse biological activities, making them highly valuable in clinical applications. They serve as antioxidants, antivirals, antimicrobials, antidiabetics, antimalarials, antitubercular agents, and anti-inflammatory agents. Their significance stems from properties such as water solubility, chemical stability, hydrogen bonding capacity, and small molecular size.

Vitamin B6 is essential for amino acid, carbohydrate, and lipid metabolism, with its active form, pyridoxal, driving key enzymatic reactions. It also plays a role in cancer biology, particularly breast cancer, which causes 11.6% of global cancer deaths. Schiff bases have emerged as potential antitumor agents by inhibiting cancer cell growth.

Molecular docking, a key tool in drug discovery, predicts how drug candidates bind to target proteins. It helps identify compounds with high affinity and specificity, advancing treatments. In cancer, it aids in designing drugs to inhibit oncogenic proteins, block pathways, or trigger apoptosis.

Considering everything mentioned, novel synthesised azomethines based on vitamin B6 and aromatic polyamine were docked to target protein. The result of the molecular docking study against Estrogen Receptor Alpha (PDB ID is 6chz) is shown in Table 1. The compound, in particular, interacted successfully as demonstrated by the binding values.

Estimated Free Energy of Binding	-8.05
Final Intermolecular Energy	-11.33
vdW + Hbond + desolve Energy	-11.20
Electrostatic Energy	-0.13
Final Total Internal energy	-1.62
Torsional Free Energy	+3.28
Unbound System's Energy	-1.62

Table 1. Molecular docking results of the compound to 6chz ($kcal.mol^{-1}$).

Acknowledgement: This work was supported by the Azerbaijan Science Foundation – Grant № AEF-GAT-7-2023-2(44)-10/08/4-M-08.

SYNTHESIS OF NOVEL 2-HYDROXYBENZALDEHYDE-TYPE AZOMETHINES

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Schiff bases are an important class of organic compounds formed by the condensation of aldehydes or ketones with amines. These substances have a high chemical and structural variability, which makes them key compounds in organic and coordination chemistry. Due to the presence of the azomethine group and other functional substituents, Schiff bases are able to stably coordinate metals, forming a variety of complexes with unique properties.

Among such compounds, orthovanillin Schiff bases stand out, which are obtained by the interaction of 2-hydroxy-3-methoxybenzaldehyde with amines. These multifunctional ligands have the ability to form strong complexes with various metals due to the presence of nitrogen of the azomethine group and two oxygen atoms from the hydroxyl and methoxy groups. Such coordination ability makes them in demand for the creation of stable metal complexes with a variety of chemical and physical properties.

Orthovanillin Schiff bases and their metal complexes also exhibit significant biological potential. They are known for their antibacterial, antifungal, antioxidant and anticancer properties. In addition, studies show their ability to interact with DNA, which opens up prospects for use in biomedical developments. In addition, such compounds are actively studied for use in the creation of polymers, dyes and pharmaceuticals, emphasizing their versatility and importance in modern scientific and applied research.

Considering everything mentioned, novel azomethine was synthesised based on salen and aliphatic polyamine. The aldehyde component was 5-bromo-o-vanillin and the amine pentaethylenehexamine. The structure of the novel Schiff base were verified using ^{1}H and ^{13}C NMR and mass spectroscopy.

Acknowledgement: This work was supported by the Azerbaijan Science Foundation – Grant № AEF-GAT-7-2023-2(44)-10/08/4-M-08.

POLYMER BRUSHES: DESIGN AND APPLICATIONS

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Nowadays, one of the widely studied objects are polymer brushes. They can be described as thin polymer films in which the individual macromolecules of polymers are tethered by one chain end to a solid interface. The polymer brushes can be synthesized by the following techniques: 'grafting to', 'grafting from' and 'grafting through'. Among them, the 'grafting from' method is perspective, because it allows to get samples with high grafting densities and film thicknesses. The grafting method is mainly carried out by surface-initiated controlled radical polymerization, and atom transfer radical polymerization (SI-ATRP) is most often applied on various surfaces.

In this work poly(N-isopropylacrylamide) (PNIPAM) and poly(2-diethylaminoethyl methacrylate) (PDEAEMA) brushes were synthesized on the surface of different substrates by using SI-ATRP method. Firstly, thermo-responsive PNIPAM is grafted from wet bacterial cellulose sheets. The modification process is followed through FTIR, XRD, elemental analysis, and atomic force microscopy. The obtained results show that wet bacterial cellulose sheets after grafting have better reswelling ability. Besides this, PNIPAM brushes were synthesized on the surface of a magnetic phosphorus-containing adsorbent. The obtained sample for vortex assisted solid phase extraction of lead in water, cigarettes and soil has been applied. Finally, a PDEAEMA brushes were decorated of the surface of graphene oxide. The fabricated nanocomposite for the separation and enrichment of Cd and Pb from food and water samples using the dispersive micro-solid phase extraction technique has been applied.

NOVEL CHALCONE SYNTHESIS USING SALICYLALDEHYDE DERIVATIVE AND 4-BROMOACETOPHENONE

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Chalcones are a prominent class of organic compounds characterized by their α, β-unsaturated carbonyl system conjugated with two aromatic rings. This unique structural motif underpins their broad spectrum of biological activities, including antimicrobial, anticancer, anti-inflammatory, antioxidant, antimalarial, and antidiabetic effects. Chalcones have been widely explored in pharmaceutical research due to their versatility, acting as precursors for synthesizing numerous heterocyclic compounds with enhanced pharmacological properties. Their role as a molecular scaffold has positioned chalcones as key players in drug discovery and therapeutic development.

The synthesis of chalcones is most commonly accomplished through the Claisen-Schmidt condensation reaction, a straightforward and efficient method. This reaction involves the base- or acid-catalyzed aldol condensation of an aromatic aldehyde with a ketone, followed by dehydration to form the chalcone framework. The process is highly adaptable, allowing for the introduction of various substituents on the aromatic rings, which can significantly alter and enhance biological activity. Factors such as reaction conditions, catalysts, and solvent systems are critical to optimizing the yield and purity of chalcones.

In addition to their biological relevance, chalcones have been explored for applications in material sciences, cosmetics, and agrochemicals, reflecting their multifaceted importance. This review provides a detailed examination of chalcones, emphasizing their structural attributes, synthesis via Claisen-Schmidt condensation, and biological activities.

By consolidating existing knowledge on chalcones, in the presence of a basic catalyst new chalcone was acquired from the reaction of 2-hydroxy-3-methoxybenzaldehyde and 4-bromoacetophenone via Claisen-Schmidt condensation. 1H, 13C, and DEPT NMR spectroscopy methods the structure of the chalcone was examined and biological activities were investigated against some bacteria.

EXAMINATION OF EFFECT OF FLUCONAZOLE ELECTRONICALLY ACTIVATED WATER AGAINST THE FUNGUS OF GENUS CANDIDA

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The phenomenon of information transfer in living systems is intensively studied by many researchers. One of the possible ways of such an impact is the transfer of the properties of biological objects to secondary carriers. These secondary carriers can influence biological objects and control their physiological processes and vital activities. From our previous studies, it was revealed that regardless of the form of bioresonance exposure (direct or inverted), it is possible to correct the morphocultural properties of yeast. This preliminary data provides prerequisites for recognizing a new scientific approach to restoring the altered properties of microorganisms using bioenergy-information transfer.

The aim of the current study is to investigate the antifungal effect of fluconazole electronically-activated physiological saline against C. guilliermondii BDU-217. Fluconazole is a potent azole antifungal drug used for treatment of infections caused by yeasts and fungi. It stops the growth of fungi. It inhibits ergosterol formation which is required for the synthesis of fungal cell membrane.

The test culture (Candida guilliermondii BDU-217) was taken from a collection of cultures at Baku State University, Azerbaijan. Candida guilliermondii is an opportunistic pathogen which can cause invasive fungal infections such as urinary tract infections, meningitis, pyelonephritis and fungemia. A capsule of fluconazole (Flukonazolum) - an antifungal drug was used. The capsule is used in the treatment of candidiasis. The drug contains the active substance: fluconazole - 150 mg and auxiliary components. For the electronic transmission of information, an IMEDIS-BRT-A bioresonance therapy device (Centre for Intelligent Medical Systems, Russia) having Serial number 2800 was used. The principle of the device is based on laws of electromagnetism and quantum mechanics. It records and analyzes vibrations during bioresonance.

Fluconazole has a wide spectrum of action against mold and yeast cultures. In medical practice, it is used in the form of a capsule. Therefore, to transfer information about fluconazole to saline in vitro, a capsule, powder and antibiotic solution were used. Fluconazole inhibited the growth of C. guilliermondii BDU-217 by 84%. Electronically activated saline from the antibiotic solution, powder and capsule inhibited the growth of the fungus by 60%, 52% and 40%, respectively. Electronically activated fluconazole from saline (false control) also inhibited culture growth by 6%. Therefore, the electronic activation of physiological saline depends on the form or state of fluconazole used. Thus, the antifungal activity of a physiological solution of an electronic activated antibiotic solution was 1.2 and 1.5 times greater than the antifungal activity activated from a dry powder and from an antibiotic capsule, respectively.

Thus, the in vitro transfer of information from the fluconazole to physiological saline using a bioresonance device has potential antifungal effects. The transfer of information from fluconazole in the form of a solution was the most effective strategy. It showed the maximum suppression of the growth of Candida guilliermondii BDU217 compared to the antibiotic powder and capsule.

SYNTHESIS OF NOVEL CHALCONE BASED ON 4-BROMOACETOPHENONE AND SALICYLALDEHYDE DERIVATIVE

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Chalcones, a versatile class of organic compounds, are defined by their α,β-unsaturated carbonyl group conjugated with two aromatic rings. This unique molecular framework provides a basis for diverse biological activities, including antimicrobial, anticancer, anti-inflammatory, antioxidant, antidiabetic, and antimalarial properties. These attributes make chalcones a cornerstone in medicinal chemistry, serving as a scaffold for developing therapeutic agents and intermediates for synthesizing bioactive heterocyclic compounds. Their structural simplicity and high reactivity allow for significant chemical modifications to improve biological performance, making them an invaluable asset in drug discovery and design.

The synthesis of chalcones is predominantly achieved through the Claisen-Schmidt condensation, a classical organic reaction involving the aldol condensation of an aromatic aldehyde with a ketone. This reaction is typically catalyzed under basic or acidic conditions, followed by dehydration to yield the chalcone framework. Factors such as the choice of catalyst, solvent, temperature, and reaction time significantly influence the yield and purity of the final product, providing opportunities for fine-tuning and optimization.

Chalcones have been extensively studied not only for their medicinal potential but also for their role in material sciences and other chemical industries. Their diverse pharmacological applications have sparked interest in understanding their mechanisms of action and structure-activity relationships.

By focusing on literature, novel chalcone was received from the reaction between 4-bromoacetophenone and 2-hydroxy-3-metoxy-5-nitrobenzaldehyde via Claisen-Schmidt condensation reaction in the presence of base. The structure of the obtained chalcone was investigated by 1H, 13C, and DEPT NMR spectroscopy methods. The biological activities of this new substance were examined against several bacteria.

SYNTHESIS AND CHARACTERIZATION OF AMINO-FUNCTIONALIZED GRAPHENE OXIDE

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Climate change, driven by the rapid increase in CO_2 emissions, poses a significant threat to ecosystems, global temperatures, and human well-being. However, CO_2, when managed efficiently, holds potential as a resource rather than a waste. One innovative approach involves utilizing CO_2 in sustainable agriculture as a source for synthesizing fertilizers, contributing to carbon recycling.

Graphene oxide (GO), with its unique structural and chemical properties, emerges as a key material for environmental and agricultural applications. GO's functional groups can be modified to create nanocomposites that enhance the efficiency of CO_2 conversion processes. Amines play a crucial role in this context, acting as effective CO_2 capture agents to facilitate the synthesis of valuable compounds.

Taking all factors into consideration, we synthesized graphene oxide (GO) modified with dodecanediamine and hexamine to enhance its functionality and explore its applications. To gain detailed insights into the structural and chemical modifications, we employed solid-state Nuclear Magnetic Resonance (NMR) spectroscopy.

SYNTHESIS OF NOVEL CHALCONE BASED ON PENTANE-2,4-DIONE AND SALICYLALDEHYDE DERIVATIVE

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The α, β-unsaturated carbonyl group coupled with two aromatic rings characterizes chalcones, a diverse class of chemical molecules. Numerous biological actions, such as antibacterial, anticancer, anti-inflammatory, antioxidant, antidiabetic, and antimalarial qualities, are based on this special chemical structure. Given these characteristics, chalcones are essential to medicinal chemistry because they can be used as a framework to create therapeutic drugs and as intermediates to create bioactive heterocyclic compounds. They are a great help in drug discovery and design because of their high reactivity and structural simplicity, which enable substantial chemical changes to enhance biological performance.

The Claisen-Schmidt condensation, a traditional chemical reaction that involves the aldol condensation of an aromatic aldehyde with a ketone, is the primary method used to synthesize chalcones. Usually conducted in an acidic or basic environment, this reaction is followed by dehydration to produce the chalcone structure. The yield and purity of the finished product are greatly influenced by variables such as catalyst selection, solvent type, temperature, and reaction duration, which offer chances for improvement and optimization.

Chalcones have been thoroughly investigated for their potential in medicine as well as for their use in the chemical and material sciences. Interest in comprehending their mechanisms of action and structure-activity correlations has increased due to their wide range of pharmaceutical applications.

The Claisen-Schmidt condensation reaction between pentane-2,4-dione and 2-hydroxy-3-methoxybenzaldehyde in the presence of base produced a novel chalcone by concentrating on literature. The 1H, 13C, and DEPT NMR spectroscopy techniques were used to examine the structure of the produced chalcone. This novel substance's biological properties were investigated against a number of bacteria.

ASSESSMENT OF THE HEALTH STATUS OF PLANTS USED IN MEDICINE

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Humans have historically utilized plants and herbs for health improvement and disease management, with around 25% of modern medications derived from plant sources. Herbal remedies are often preferred by individuals over conventional medicines. Despite their long history of use, there is a lack of systematic assessment regarding the safety and effectiveness of herbal treatments. The effectiveness of these remedies can vary due to differences in plant species, growing conditions, and potential contamination with toxic substances. Thus, the quality control of the plants used to produce herbal medicines directly influences their safety and effectiveness. Herbal Medicine: Biomolecular and Clinical Aspects, Second Edition. CRC Press.). Various methods can be used to assess the health and quality of plants used in medicine, ranging from the microscopic to the macroscopic level.

In our studies, we assessed the stability of development in various woody and herbaceous plants using a range of anatomical, morphological, physiological, and biochemical methods. The species examined included *Triticum aestivum* L., *Triticum durum* L., *Hordeum vulgare* L., *Olea europaea* L., *Ligustrum japonicum* L., *Populus nigra* L., *Quercus ilex* L., *Quercus longipes* Stev., *Quercus iberica* Stev., and others. To assess the stability of plant development, we used the fluctuating asymmetry method. It is an effective way to evaluate plant development stability, reflecting morphogenetic homeostasis. It involves measuring deviations from bilateral symmetry during development, allowing for the assessment of microscopic cellular changes based on macroscopic observations. An important indicator of plant health is the stability of its physiological state. An essential indicator of plant health is the stability of its physiological state. For a quick and reliable assessment of the physiological condition of the photosynthetic apparatus, we recommend using the chlorophyll fluorescence method. This method is advantageous because it serves as a straightforward integral indicator of plant physiological status and can highlight pathophysiological changes (Mammadova A., Farzaliyeva N, & Mammadova R. (2017). Environmental Assessment of the Tree Plant Leaves According to their Physiological State and Fluctuating Asymmetry Indices of Morphological Features,

Which Widely Spread in Baku. *Journal of Ecology of Health & Environment*, *5*(1), 19–21). Also, our studies focused on the elemental composition of plants using X-ray fluorescence analysis (XRF) to quantify the content of elements. Understanding the chemical composition and the quantity of elements in plants is essential for using them to correct imbalances of vital chemical elements in the body. The pharmacological activity of plants is determined by their chemical elements, while the expected therapeutic effect relies on their quantity (Mammadova A., Muhammad Z., & Mammadova R. (2024). Indicative and remediative properties of Vicia Faba L. Baku State University Journal of Life Sciences & Biology 1 (1), 3-12).

Thus, assessing the potential of various plants for medicinal use requires a comprehensive approach that includes evaluating both the health of the plants and their pharmacological significance.

THE ROLE OF ATP MEASUREMENT IN ENSURING ENVIRONMENTAL SAFETY AND SUSTAINABLE USE OF NATURAL RESOURCES

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Environmental safety, efficient use of natural resources, and the restoration and preservation of natural systems are crucial for sustainable development. Rapid industrialization and urbanization have increased the risk of contamination in production processes, directly impacting environmental quality and human health. To address these challenges, advanced methodologies like ATP (Adenosine Triphosphate) measurement have emerged as reliable tools for monitoring and controlling contamination. This thesis explores the relevance of ATP measurement in ensuring environmental safety, promoting efficient resource use, and supporting sustainable development.

ATP measurement is a bioluminescence-based technique used to detect biological contamination. The methodology includes sample collection, reaction initiation, and data analysis. Samples are collected from critical control points using sterile swabs to prevent cross-contamination. Swabs are then inserted into luminometers containing luciferase enzymes. The resulting light emission indicates ATP presence, which is proportional to contamination levels. Relative Light Units (RLUs) are recorded and compared with standard thresholds to assess

contamination levels. This study also integrates traditional microbiological methods for validation, ensuring comprehensive and reliable results.

The findings demonstrate that ATP measurement offers several applications, including environmental monitoring, efficient resource use, natural system restoration, and policy implementation. It helps identify contamination trends in industrial processes to reduce ecological impact, minimizes waste and optimizes production processes to enhance sustainability, supports clean-up operations by providing real-time contamination data for effective interventions, and facilitates compliance with environmental regulations through accurate and timely monitoring.

Research conducted in production facilities highlights the effectiveness of ATP measurement in providing rapid and objective contamination assessments, enhancing the efficiency of cleaning protocols, reducing waste, and identifying contamination sources to aid in preventive measures. The correlation between ATP measurements and traditional microbiological results confirms the method's reliability. Implementation in industries such as food production and pharmaceuticals has significantly improved environmental quality and operational efficiency.

ATP measurement is a pivotal tool for promoting environmental safety and sustainable resource management. Its rapid, reliable, and cost-effective nature makes it indispensable for routine monitoring and contamination control. Future research should focus on expanding its applications, particularly in renewable energy production and ecological restoration projects. By integrating ATP measurement into environmental safety protocols, industries can achieve sustainable socioeconomic development while preserving natural systems for future generations.

EVALUATION OF COTTON VARIETIES BASED ON TOLERANCE INDICES UNDER SALT STRESS CONDITIONS

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Cotton is the world's sixth-largest source of vegetable oil and the most significant renewable natural textile fiber. The United States is by far the greatest producer of cotton, followed by China, India, Pakistan, Uzbekistan, and West African nations. Since most producers are becoming large consumers of their own production and even import cotton because of their growing spinning and textile

businesses, just 30% of the world's total production is exported each year. Cotton also plays an important role in the socio-economic development of Azerbaijan.

One of the main tasks of cotton breeding today is the identification of genotypes resistant to biotic and abiotic stress factors in addition to high fiber yield and fiber quality and their recommendations for breeding programs. Therefore, the main goal of the study is to identify genotypes resistant to abiotic stress (salt) of local and introduced cotton collection samples in our country using multivariate statistical methods and select promising samples for future breeding programs.

31 local and introduced genotypes of cotton (*Gossypium hirsutum* L.) stored in the National Genebank were used as the material for the study. Genotypes were grown under conditions of control and 200 mM NaCl salt concentration stress according to the methodology proposed by Basal (2010), and the resistance indices were calculated based on dry weight as follows (Fischer & Maurer, 1978):

Stress susceptibility index (SSI)	$\frac{1-\frac{Ys}{Yp}}{1-\frac{\overline{Ys}}{\overline{Yp}}}$
Stress Tolerance Index (STI)	$\frac{Yp \times Ys}{(\overline{Yp})^2}$
Mean Productivity (MP)	$(Y_p+Y_s)/2$
Geometric Mean Productivity (GMP)	$\sqrt{(Yp \times Ys}$
Yield Index (YI)	$Y_s/\overline{Y}_s$
Stress Susceptibility Percentage *Index* (SSPI)	$TOL\times100/(2\times\overline{Y}_p)$
Modified Stress Tolerance Index (MSTI)	$(YI)^2\times STI$
Tolerance (TOL)	Y_p-Y_s

Y_p and Y_s are the average dry weight of given genotype under control and NaCl stress conditions, respectively. $\overline{Y}_p$ and $\overline{Y}_s$ are the average dry weight of all genotypes under control and NaCl stress conditions, respectively.

It was noted that genotypes with low values of TOL, SSPI and SSI indices and high values of STI, YI, MP, GMP and MSTI indices exhibited higher stability under salt stress conditions. As a result of the conducted research, the lowest value of SSI index was determined in Tashkent-2 (0.124), and the lowest values of TOL and SSPI indices were determined in Beyaz altun-440 variety (0.003 and 0.982, respectively). The highest value of STI, MP, YI and GMP indices was determined in Ganja-110 variety (5.314, 0.316, 2.18, 0.315, respectively). The highest value of MSTI was observed in Tashkent-2 and Beyaz altun-440 varieties (0.974). As a result of a comprehensive analysis, the varieties Beyaz altun-440 from Turkey and Tashkent-2 from Uzbekistan were selected as salt-resistant varieties.

SYNTHESIS, CHARACTERIZATION, AND BIOLOGICAL EVALUATION OF NOVEL BENZO[B]THIOPHENE DERIVATIVES

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The synthesis of novel benzo[b]thiophene derivatives was achieved via Suzuki-Miyaura cross-coupling reactions, utilizing two distinct palladium-based catalytic systems: tetrakis(triphenylphosphine)palladium(0) and bis(triphenylphosphine)palladium(II) dichloride. Reactions were conducted in a variety of solvents, including dioxane, dimethylformamide (DMF), and toluene, to optimize yields and reaction efficiency. Purification of the resulting products was performed using column chromatography, and the structures of all synthesized compounds were thoroughly characterized by nuclear magnetic resonance (NMR) spectroscopy, Fourier-transform infrared (FT-IR) spectroscopy, and ultraviolet-visible (UV-Vis) spectroscopy.

The biological activity of the synthesized benzo[b]thiophene derivatives was evaluated against Staphylococcus aureus and Escherichia coli. The results revealed notable antibacterial efficacy against S. aureus, while activity against E. coli was less pronounced. Additionally, cytotoxicity studies were conducted using MTT assays on MC3T3 osteoblast cell lines to assess biocompatibility. The findings demonstrated that functionalized benzo[b]thiophene derivatives exhibit significant antibacterial activity against S. aureus with minimal cytotoxicity, underscoring their potential as candidates for biomedical applications. These applications may include antibacterial coatings or drug delivery systems, where both antimicrobial efficacy and biocompatibility are essential.

STUDY OF METABOLITES OF EPHEDRA DISTACHYA L. FROM THE FLORA OF AZERBAIJAN

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In order to search for new possible sources of biologically active substances and medicinal preparations, we studied twigs with flowers Ephedra distachya L. (family Ephedraceae), isolated and identified steroid - β-sitosterol, pentacyclic triterpenoid - ursolic acid, flavonoids - apigenin (5,7,4'-trihydroxyflavone), kaempferol (3,5,7,4'-tetrahydroxyflavone) and kaempferol-3-O-α-L-rhamnoside (afzelin)

The study of local plant materials is driven by the search for new sources of biologically active substances and medicines, which is a relevant area of pharmaceutical science. Species of the genus Ephedra L. are widely used in traditional medicine in various countries. Of the 32 species of Ephedra L. growing in moderately arid regions worldwide, 4 species are found in the Caucasus and Azerbaijan.

The research focused on the flowering twigs of Ephedra distachya L. (family Ephedraceae), collected in late May 2023 on the Absheron Peninsula. Acetylation of the isolated substances was performed using freshly distilled acetic anhydride in the presence of pyridine. Concentration was carried out on an IKA RV8 rotary evaporator. Identification of the isolated substances was based on physicochemical properties, spectral data (UV, IR), and comparisons with authentic samples.

Approximately 1.5 kg of air-dried upper parts of flowering twigs of *E. distachya* L. were extracted three times with ethanol. The first extraction used a 1:10 raw material-to-solvent ratio, the second 1:8, and the third 1:6. The extracts were combined, concentrated on a rotary evaporator at 50–60°C to 200 ml, and sequentially extracted with hexane, chloroform, a mixture of ethyl acetate and hexane, and ethyl acetate.

From the hexane extract, 0.220 g of β-sitosterol was isolated. From the chloroform extract, 0.355 g of ursolic acid was obtained. From the ethyl acetate-hexane mixture extract, 0.310 g of apigenin and kaempferol were isolated. From the ethyl acetate extract, 0.200 g of kaempferol-3-O-β-L-rhamnoside (afzelin) was obtained.

For the first time, β-sitosterol, ursolic acid, apigenin, kaempferol, and afzelin were isolated and identified from the aerial parts of *Ephedra distachya* L. in the flora of Azerbaijan.

THE STUDY OF NANOPARTICLE - CHLOROPHYLL INTERACTION BY UV-VIS SPECTROSCOPY

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The photochemical and photo physical properties of chlorophyll, an important pigment of the photosynthesis process, have been widely studied. In connection with the intensive development of nanotechnology, the interaction of nanomaterials, including nanoparticles, with plants has also recently begun to be studied in detail. The interaction of nanoparticles with plants refers to their absorption by plants, transport within plants, and their effect on several physiological processes, including germination, development and growth, mineral nutrition of plants, and finally photosynthesis and biochemical reactions. The most important of such interactions is the elucidation of the mechanism of the effect of nanoparticles on the photosynthesis process and its main pigment, chlorophyll. The elucidation of the mechanism of these effects depends on the study of the interaction of nanoparticles with biological molecules.

In the presented research, the effect of ZnO nanoparticles on the photophysical parameters of the chlorophyll molecule extracted from the leaves of the bean plant was studied. For the interaction of chlorophyll molecules with ZnO nanoparticles, 1 ml of chlorophyll solution was added to 10 ml of ZnO nanoparticle solution sonicated in an ultrasonic device for 30 minutes. The resulting nanoparticle-chlorophyll mixture, as well as the chlorophyll solution without added nanoparticles, were kept for 24 hours in both the dark and light. Then, the UV-Vis spectra of these solutions were recorded separately between the wavelength range of 250 nm and 750 nm. Two bands are observed in the UV-vis absorption spectrum of a normal chlorophyll solution without nanoparticles added and stored in the dark: a blue band at 430 nm and a red band observed at 661 nm. These bands are also observed in a chlorophyll solution with ZnO nanoparticles added, but their amplitude is reduced. This indicates that the light absorption intensity of chlorophyll decreases during the nanoparticle-chlorophyll interaction. When the dependence of the obtained effect on the concentration of ZnO nanoparticles was investigated, it was found that the absorption intensity of chlorophyll does not increase with increasing concentration of nanoparticles. However, it is clear from the UV-vis spectra of the chlorophyll+ZnO solution stored in the light that degradation of chlorophyll occurs normally and ZnO nanoparticles weaken this degradation. The results of the

experiments allow us to make important observations about the mechanism of the interaction between chlorophyll and zinc oxide nanoparticles. Zinc oxide nanoparticles reduce the light absorption of chlorophyll, suggesting that this process is spontaneous and exothermic. In addition, it is also possible that electron transfer occurs between chlorophyll and zinc oxide nanoparticles during the interaction.

INVESTIGATION OF THE ANTIBACTERIAL ACTIVITY OF A NOVEL TETRAHYDROPYRIMIDINE DERIVATIVE AGAINST GRAM NEGATIVE BACTERIA

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Antibiotic resistance is a critical global health issue. It occurs when bacteria adapt to withstand the effects of antibiotics that previously eliminated them, making some infections challenging to treat. In 2019, bacterial antimicrobial resistance (AMR) was directly responsible for an estimated 1.27 million deaths worldwide and contributed to 4.95 million deaths overall. Nowadays antibiotic resistance is considered one of the most concerning and developing challenges in the world. WHO claimed that annually, antibiotic-resistant microbes are responsible for more than a million infections which cause at least 23.000 deaths in the USA, and it is expected that the number of fatalities will increase tenfold by 2050. Tetrahydropyrimidines and their derivatives have recently attracted considerable interest because of their diverse pharmacological activities, such as anticancer, antiviral, calcium channel modulation, and antibacterial properties. In this work, 5A - methyl 4-(3,4-dihydroxyphenyl)-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate; 6A - 4-(5-(methoxycarbonyl)-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidin-4-yl) benzoic acid and 7A - methyl 4-(2,3-dichlorophenyl)-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate were synthesized by Biginelli reaction. The antibacterial activity screening of the synthesized compounds was investigated against *Escherichia coli*; *Acinetobacter baumanii*; *Pseudomonas aeruginosa; Klebsiella pneumoniae; Salmonella typhi* by two-fold microdilution assay. Obtained results were compared with the results of the antibiotic (ampicillin). 5A compound showed the most activity against *A. baumanii*, which MIC value was 16 μg/mL and showed the least activity against *Klebsiella pneumoniae,* which MIC value was 256

μg/mL. 6A compound showed the most activity against *P. aeruginosa* the MIC value was equal 16 μg/mL and the least activity against both *Klebsiella pneumoniae* and *Salmonella typhi,* which MIC value was 256 μg/mL. 7A compound showed the most activity against both *A. baumanii* and *P. aeruginosa,* which MIC value was 128 μg/mL, and the least activity against *Klebsiella pneumoniae,* which MIC value was 512 μg/mL. Between these 3 compounds, 6A - 4-(5-(methoxycarbonyl)-6-methyl-2 -oxo-1,2,3,4-tetrahydropyrimidin-4-yl) benzoic acid compound was the most active compound but 7A methyl 4-(2,3-dichlorophenyl)-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate compound was the weakest active compound. Ampicillin showed the most activity against *A. baumanii,* which MIC value was 16 μg/mL and the least activity against *Salmonella typhi,* which MIC value was ≥512 μg/mL.

INVESTIGATION OF THE ANTIBACTERIAL ACTIVITY OF A NOVEL TETRAHYDROPYRIMIDINE DERIVATIVE AGAINST *STAPHYLOCOCCUS AUREUS*

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Currently, antibiotic resistance is regarded as one of the most serious and emerging concerns globally. Each year, antibiotic-resistant microorganisms cause approximately one million infections, resulting in at least 23,000 fatalities in the USA, with estimates indicating a tenfold increase in deaths by 2050. Heterocyclic derivatives, as a significant category of organic chemicals, are extensively utilized in various pharmacological and industrial applications. They are recognized for their biological and pharmacological attributes, which encompass anti-inflammatory, antibacterial, anticancer, antitumor, and antiviral activity. Pyrimidine and pyrimidine-containing rings have garnered significant interest due to their presence in the substructures of therapeutically essential compounds. Tetrahydropyrimidines and their derivatives have recently garnered significant attention due to their pharmacological properties, including anticancer, antiviral, calcium channel regulation, and antibacterial actions. In this work, methyl 4-(3, 5-dibromophenyl)-

6-methyl-2-oxo-1, 2, 3, 4-tetrahydropyrimidine-5-carboxylate derivative **(1AS)** was synthesized by Biginelli reaction. The initial antibacterial activity screening of the synthesized compound was investigated against *Staphylococcus aureus* ATCC25923, *Staphylococcus aureus* 1199, and *Staphylococcus aureus* 1199B, *Staphylococcus aureus* NRS385 by agar disc diffusion assay. The compound was dissolved in DMSO and the concentration of the compound was 1000 μg/mL. According to the results, **1AS** compound showed high activity against *S.aureus* ATCC25923 and *S.aureus* 1199 strains. The inhibition zone of the compound was 32 and 28 mm against bacterial strains, respectively. *Staphylococcus aureus* 1199B and *Staphylococcus aureus* NRS385 were less susceptible against tested compound. After initial screening the minimum inhibitory concentration (MIC) of the synthesized compound was detected in case of *S.aureus* ATCC25923 and *S.aureus* 1199 strains by two fold microdilution assay. Obtained results were compared with the results of the antibiotic (ampicillin). The compound MIC value was 32 μg/mL against *S.aureus* 1199 and 16 μg/mL against *S.aureus* ATCC25923. The MIC value of ampicillin against *S.aureus* 1199 and *S.aureus* ATCC25923 strains was 16 μg/mL and 8 μg/mL respectively.

SYNTHESIS OF A NEW BIOLOGICALLY ACTIVE HETEROCYCLE BY BIGINELLI REACTION

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Antibiotic resistance is a global threat that is growing rapidly and requires immediate measures to prevent catastrophic consequences in the future, such as increase of thr deaths and complications from infectious diseases. Bacteria, viruses and fungal due to their short life mutate and become resistant to antibiotics. Antibiotic resistance is a widespread problem, and solving it requires the development of new substances with a wide range of properties.

Dihydropyrimidines obtained by the scientist Biginelli by the reaction of the same name in 1875 can be used as new drugs due to their various properties. Dihydropyrimidine derivatives have many functional groups in their structure, due to which they have such properties as antimalarial, antibacterial, calcium and potassium channel blockers, antiviral, antifungal, anti-tuberculosis, anti-inflammatory, anti-HIV and others are manifested.

In view of all of the above, we decided to obtain novel dihydropyrimidine with biological activity. The cyclocondensation reaction of the three reaction components is carried out using a catalyst. The one-stage reaction catalyzed by ammonium chloride involves the use of ortho bromine vanillin, thiourea and acetylacetone. The structure of the obtained compounds was confirmed by NMR and Mass spectroscopy.

Acknowledgement: This work was supported by the Azerbaijan Science Foundation - Grant № AEF-GAT-7-2023-2(44)-10/05/3-M-05

SYNTHESIS AND INVESTIGATION OF A NEWLY MODIFIED BIOLOGICALLY ACTIVE DIHYDROPYRIMIDINE

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The development of the pharmacological and medical industries and the expanded use of medicines leads to the formation of resistance in many microorganisms. Viruses, bacteria and fungi mutate, thereby becoming resistant to antibiotics and antifungal drugs.

In conditions of increasing resistance of microorganisms to drugs, there is an urgent need for the synthesis of new antifungal, antibacterial and antimicrobial drugs.

Recently, pyrimidine heterocycles, which have a number of advantageous properties as medicinal agents, have attracted increasing attention. About their

wide range of antibiotic, antibacterial, antifungal, anti-inflammatory, anti-plague, antimalarial, anti-inflammatory, antiviral, antimicrobial, anti-HIV, antidiabetic, herbicidal, fungicidal and insecticidal agents. At the moment, many chemical compounds consisting of pyrimidine components have been synthesized and studied, as well as their antimicrobial activity has been evaluated in areas such as hypertension treatment, cancer cell control, antimicrobial, as well as for use as antiarrhythmic, anti-inflammatory, antiviral and anti-tuberculosis agents.

Due to the wide range of therapeutic properties and interest in this class of compounds, we also synthesized a new biologically active dihydropyrimidine using the three-component Biginelli reaction.

A single-stage condensation reaction of 2,3 dimethoxy 1-naphthaldehyde, acetyl acetone and thiourea was catalyzed by ammonium chloride, as well as the samples obtained were examined for biological activity. The structure of the newly modified compounds was analyzed by NMR and Mass spectroscopy.

Acknowledgement: This work was supported by the Azerbaijan Science Foundation - Grant № AEF-GAT-7-2023-2(44)-10/05/3-M-05

ECOTOXICITY TESTING METHODS AND MODELS

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Biological assessments, also called bioassays which determine biological responses against xenobiotics are crucial tool in ecotoxicology. Ecotoxicological bioassays provide essential data for environmental monitoring and risk assessment. This lecture emphasizes the significance and roles of acute and chronic toxicity testing methods and models with vertebrates in ecotoxicology. It particularly focused on "in vivo bioassays" exemplifying with various case studies used amphibian and mammalian models in environmental risk assessment. Biochemical, hematological and histopathological effects of pesticides were demonstrated by using mammalian toxicity test models (Figs 1-2). As amphibian embryos can be used in toxicity studies as indicators of environmental quality for wildlife protection purposes, we also use native amphibian species of Türkiye as model organisms in ecotoxicological risk assessments of wetland ecosystems. Mortality, malformation, and inhibition of development and growth were considered as end points to evaluate the toxicity in these models (Figs. 3). As a reliable and realistic amphibian model, employing

ecological relevant species of Türkiye for evaluating the potential risks of xenobiotics does not exist, an ecotoxicological test model with native species of Türkiye, *Bombina bombina*, was described and named as "BOMBİNATOX". It was found to be useful in testing developmental toxicity of pollutants and to meet both ecologic and economic criteria. This kind of innovative implementations in bioassay methodologies have been enhancing the accuracy and efficiency of ecotoxicological assessments contributing to the protection of environmental health and biodiversity against increasing environmental challenges.

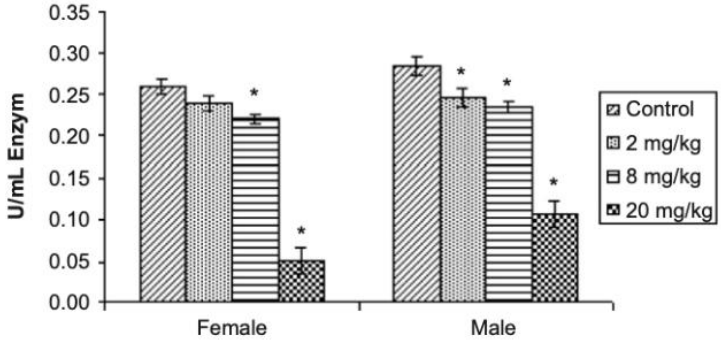

Figure 1. Liver cholinesterase enzyme activities of rats exposed to Dimethoate, an organophosphorus pesticide. *Statistically significant difference from control (p≤0.05) (Sayım, 2007a)

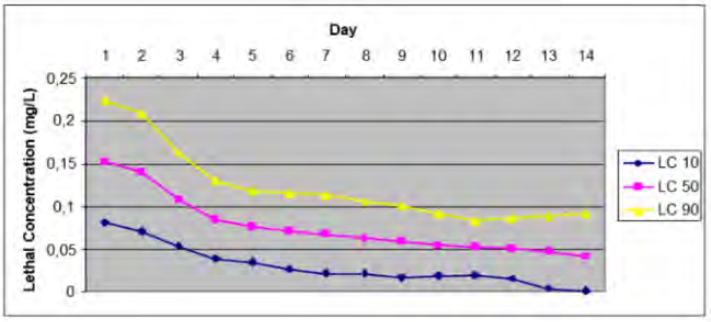

Figure 2. Toxictiy profile curves of Cu^{+2} for *B. bombina* from larval-toxictiy tests

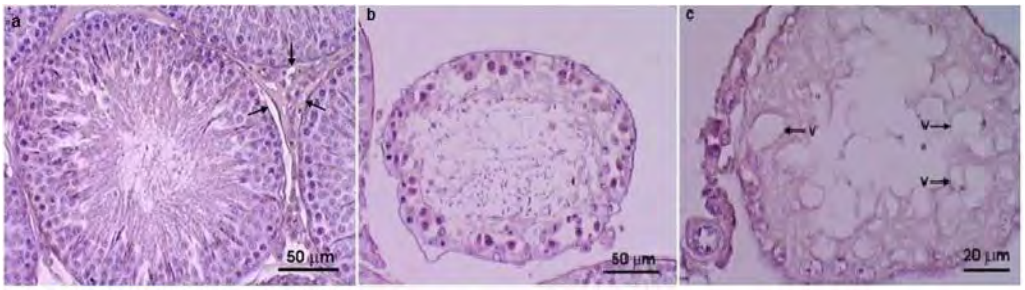

Figure 3. Testicular sections of rats **a)** control **b)** exposed to 8 mg/kg and c) 20 mg/kg Dimethoate. (b, c) shows seminifer tubule degeneration; atrophic tubule. v vacuolization in sertoli cells.

THE EFFECT OF CHITOSAN-BASED COMPLEXES ON WHEAT (TRITICUM DURUM) DEVELOPMENT

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Wheat, as the most widely grown and consumed cereal crop in the world, is a crucial agricultural product. The high yield and quality of wheat are among the essential factors for the sustainable development of agriculture. However, the use of chemical fertilizers and pesticides in wheat production has led to ecosystem disruption. Chitosan, a natural polysaccharide derived from chitin found in the shells of crustaceans and certain fungi, is known for its plant growth-stimulating properties. It strengthens plant root systems, improving water and nutrient absorption, and accelerates the growth of leaves and branches, boosting photosynthesis. Chitosan also has antimicrobial and antifungal effects, helping protect plants from pathogens. Its application contributes to increased plant productivity and overall health. Indole-3-acetic acid (IAA), commonly known as auxin, is a type of phytohormone that plays a vital role in plant growth and development. IAA regulates cell elongation and division by softening the cell walls, promotes root formation, and accelerates plant growth. Additionally, IAA enhances the plant's ability to respond to stress and improves its survival under diverse environmental conditions. As a result, the application of IAA in plant development and agriculture offers significant potential for boosting crop yields and enhancing soil fertility. Seed priming is a technique to enhance plant growth by improving seed viability, germination rates, and uniformity. It involves treating seeds with chemicals like hormones,

micronutrients, or growth regulators to boost germination and development. Hormonal priming, particularly with auxins like IAA and gibberellins, accelerates seed germination. This method also promotes strong root system development, improving nutrient and water absorption. The research focuses on examining how different concentrations of IAA and chitosan affect catalase activity. In the experiments conducted, the local Azerbaijani wheat variety "Ravan" was used for seed treatment. The seeds were primed with six different concentrations: 1) control; 2) 0.01 g Cht; 3) 0.001 g Cht; 4) 10 μM IAA; 5) 10 μM IAA + 0.01 g Cht; 6) 10 μM IAA + 0.01 g Cht. The priming process was carried out at 4°C for 24 hours. The primed seeds were then sown in cocopeat substrate and irrigated with a hydroponic solution for 14 days. The experimental analysis showed that the concentration of 10 μM IAA + 0.01 g Cht led to an increase in catalase activity. The application of chitosan can induce defense mechanisms in plants, which increases the production of reactive oxygen species and thereby activates the plant's antioxidant system, including catalase activity. As a result, an increase in catalase activity is observed, helping the plant cope with stress conditions such as drought, salinity, or pathogen attacks. In these processes, the catalase enzyme plays a crucial role, as it breaks down hydrogen peroxide in plant cells, preventing oxidative damage. The results showed that catalase activity increased by 14.4% at a concentration of 10 μM IAA + 0.01 g Cht compared to the control samples. The experimental results showed that applying chitosan at a concentration of 10 μM IAA and 0.01 g Cht activated defense mechanisms in plants, increasing reactive oxygen species production and enhancing catalase activity. This boost in catalase activity suggests that the enzyme helps protect plants by reducing oxidative damage. The 10 μM IAA concentration significantly affected the plant's morphology, particularly increasing root and leaf length. These findings highlight the stimulatory effect of IAA on plant growth, contributing to the development of stronger, healthier plants. Overall, IAA plays a key role in enhancing plant morphology and vitality.

ECO-FRIENDLY APPLICATIONS OF NOVEL HYBRID MATERIALS

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The development of hybrid materials combining organic and inorganic entities has revolutionized material science, providing versatile solutions for various applications. One such innovation is the synthesis of 4-chloroanilinium trichloromercurate (II), a hybrid material with potential eco-friendly applications. This material, prepared via slow evaporation, demonstrates promising structural, thermal, and biological properties that contribute to sustainable advancements in chemistry and material sciences.

The compound $(C_6H_7ClN)[HgCl_3]$ was synthesized by reacting mercury chloride with 4-chloroaniline, followed by a crystallization process over 19 days. The crystalline structure belongs to the triclinic system with space group P-1, exhibiting alternating organic cations $(C_6H_7ClN)^+$ and inorganic anions $[HgCl_3]^-$.

Infrared spectroscopy confirmed the presence of functional groups, with characteristic NH_3^+ stretching vibrations between 3200–2550 cm^{-1}. The UV-Vis spectroscopy revealed the material's wide-bandgap semiconductor nature, with a bandgap energy (Eg) of 3.893 eV. Thermogravimetric analysis (TGA) indicated two distinct decomposition phases, correlating to the removal of specific organic and inorganic fragments. The compound's dielectric properties were investigated, showing temperature-dependent behavior due to ionic and interfacial polarization.

Molecular docking studies highlighted the material's potential as an antibacterial and antifungal agent. The $(C_6H_7ClN)[HgCl_3]$ ligand exhibited effective interactions with bacterial proteins (e.g., 4JUR, 3MJM) and fungal proteins (e.g., 2WVU, 4LE8), achieving binding energies as low as -60.75 kcal/mol. These interactions suggest a promising role for this hybrid material in developing sustainable antimicrobial agents.

The 4-chloroanilinium trichloromercurate (II) hybrid material exemplifies the integration of advanced material science with sustainability. Its structural and functional characteristics pave the way for applications that align with eco-friendly and sustainable goals. Further research could expand its utility across diverse fields, solidifying its role in promoting green chemistry initiatives.

COMPARATIVE ANALYSIS OF VOLATILE OILS IN *GENTIANA L.* SPECIES FROM AZERBAIJAN

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Iridoids, xanthones, triterpenes, and flavonoids dominate the biologically active compounds found in species of *Gentiana L. Gentiana L.* species are not typically rich in volatile oils, however, studies on certain species such as *G. lutea, G. punctata, G. macrophylla, and G. asclepiadea* have revealed their significant volatile oil content. In this context, it is of significant importance to conduct a quantitative and qualitative analysis of the essential oils in *Gentiana* species distributed in Azerbaijan.

The air-dried and finely powdered aerial and underground parts of *G. septemfida, G. gelida, and G. cruciata* (100 g each) were individually mixed with 1 liter of purified water in 2-liter flasks. Volatile oils were extracted by hydrodistillation using a Clevenger apparatus for 4 hours. The extracted volatile oils were stored at 4°C in a refrigerator until further analysis by GC-MS and GC methods.

The GC-MS analysis was performed using an Agilent 5975 GC-MSD system. Helium was used as the carrier gas at a flow rate of 0.8 mL/min, and separation was achieved with an Innowax FSC column. The oven temperature was initially maintained at 60°C for 10 minutes, then increased to 220°C for 10 minutes. Subsequently, the temperature was increased to 240°C. The split ratio was adjusted to 40:1, and the injector temperature was set at 250°C. Mass spectra were recorded at 70 eV, with a mass range of 35–450 m/z.

The GC analysis was conducted using an Agilent 6890N GC system. The flame ionization detector (FID) temperature was set at 300°C. The elution process, including analytical conditions, column application, and injection time, followed the same procedures as described for the GC-MS analysis. The relative percentage composition of the separated compounds was calculated using the FID response data. The identification of essential oil components was carried out by comparing their relative retention times (RRT) with those of the original samples or with the retention index (RI) of a series of n-alkanes. The following databases were utilized for the identification: The Wiley GC/MS Library, MassFinder Software 4.0, and an internal "Essential Oils Database" based on known compounds and components of essential oils.

The volatile oil composition of *G. septemfida* was dominated by terpenes, including spatulanol, globulol, viridifrolol, hexahydrofarnezyl acetone, linalool, α-terpineol, and hexanal. The volatile oil derived from *G. gelida* contained 3.8% hexahydrofarnezyl acetone, 3.1% spatulanol, alongside a mixture of 73.8% hexadecanoic acid, 7.9% tetradecanoic acid, and other compounds. The volatile oil of *G. cruciata* contained 1.9% hexahydrofarnezyl acetone. The volatile oil from the root of this plant was predominantly composed of terpenes, with 0.5% hexahydrofarnezyl acetone and 66.3% hexadecanoic acid as the major components.

In conclusion, the qualitative and quantitative analysis of volatile oils extracted from the herb and root parts of *G. septemfida, G. cruciata, and G. gelida* species using the Clevenger method, followed by GC and GC-MS techniques, reveals that sesquiterpenes are the dominant compounds in these plants. Furthermore, the oils are characterized by high concentrations of hexadecanoic acid, pentadecanoic acid, and tetradecanoic acid, highlighting the significant presence of these fatty acids in the volatile oil profiles of these species.

MODIFICATION OF DNA BASED NANODISCS WITH AMPHIPHILIC POLYMERS

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Membrane proteins comprise class of the receptors that play a key role in cell signaling and ion transport. Despite being promising drug targets, most of the membrane proteins are underinvestigated due to their challenging isolation and purification that requires the use of detergents. Application of the detergents in isolation and stabilization disrupt the structure and function of membrane proteins by not providing native lipid bilayer. In recent decades preference is toward non-detergent isolation and stabilization of membrane proteins by the application of amphiphilic macromolecules, such as: membrane scaffold protein (MSP), amphiphilic polymers (A8-35, Ultrasolute-18), stryrene-maleic acid (SMA) co-polymers, amphiphilic peptides and DNA-based minicircles.

DNA-encircled lipid bilayers are advantageous because of precise size control and sites for the functionalization. By modifiying DNA minicircles with amphiphilic

polymers we aim to achieve high complex stability and solubilization of lipids/membrane proteins without applying detergents. In present study we modified previously established DNA-minicircles with commercially available amphiphilic polymer A8-35 and stryrene-maleic acid (SMA) co-polymer (BZ-40) via EDC/NHS cross-coupling reaction. The recieved nanostructures were investigated by gel electrophoresis, analytical ultracentrifugation (AUC), atomic force microscopy (AFM) and transmission electron microscopy (TEM).

REUSE OF TREATED WASTEWATER: ENVIRONMENTAL AND ECONOMIC BENEFITS

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The reuse of treated wastewater is a sustainable and innovative approach to addressing the growing challenges of global water scarcity and environmental degradation. Freshwater resources are under immense pressure due to population growth, industrialization, urbanization, and the impacts of climate change. By recycling wastewater, societies can reduce the strain on natural water sources while promoting environmental protection and economic efficiency. Treated wastewater has proven to be a valuable resource, particularly in agriculture, industrial processes, and urban areas. It can replace freshwater for irrigation, cooling systems, construction activities, and even groundwater recharge, reducing the over-extraction of rivers, lakes, and aquifers.

The environmental benefits of wastewater reuse are significant. It helps minimize pollution by reducing the volume of untreated wastewater released into ecosystems, thereby protecting water quality and aquatic life. Moreover, using recycled water reduces the reliance on freshwater sources, ensuring the preservation of natural habitats and promoting ecological balance. In agriculture, treated wastewater serves as a reliable water source, especially in arid and semi-arid regions, supporting food production without depleting limited freshwater supplies. Additionally, treated wastewater often contains nutrients like nitrogen and phosphorus, which act as natural fertilizers, reducing the need for chemical inputs and contributing to soil health.

From an economic perspective, the reuse of treated wastewater leads to cost savings at multiple levels. Industries and municipalities benefit from reduced

expenses in freshwater extraction, transport, and treatment. For example, industries requiring substantial volumes of process water, such as energy production and manufacturing, can achieve operational efficiency by utilizing recycled water. In agriculture, reliable access to treated wastewater ensures stable crop yields, even in drought-prone areas, boosting food security and supporting local economies. Municipalities also benefit from lower energy consumption in water treatment plants, reducing operational costs and the overall environmental footprint.

However, despite its numerous advantages, the adoption of wastewater reuse faces challenges. Public concerns over water quality, inadequate infrastructure, and regulatory barriers often hinder its widespread implementation. To overcome these issues, governments and organizations must invest in advanced treatment technologies, such as membrane filtration and UV disinfection, to ensure water safety. Public awareness campaigns can also help change perceptions and promote acceptance of recycled water as a viable resource.

In conclusion, the reuse of treated wastewater is a vital step toward sustainable development, offering a practical solution to water scarcity while providing environmental and economic benefits. By addressing existing challenges and prioritizing innovation, this practice can contribute significantly to global water security and the preservation of natural ecosystems.

PORPHYRIN SYNTHESIS UNDER SOLVENT-FREE CONDITION AND INVESTIGATION OF ITS INFLUENCE IN IRRADIATED SUBSTANCES BY PHOTODYNAMIC THERAPY METHOD

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As we know, in the recent decades, cancer has become one of the most dangerous disease that spreads rapidly over the world. Cancer is a group of diseases, which involves abnormal cell growth with the potential to invade or spread to other parts of the body. These contrast with benign tumors, which do not spread. Possible signs and symptoms are as follows: a lump, abnormal bleeding, prolonged cough, unexplained weight loss and a change in bowel movements. While these symptoms may indicate cancer, they can also have other causes. For instance, certain

infections, tobacco use, excessive drinking of alcohol, exposure to ionizing radiation, environmental pollutants, etc.

There are many types of cancer treatments. These are surgery, radiation therapy, chemotherapy, immunotherapy, hormone therapy, etc. One of the common treatment method for cancer is chemotherapy, but more recently photodynamic therapy (PDT) became pretty popular. Photodynamic therapy (PDT), is a type of phototherapy involving light and a photosensitizing chemical substance (called a photosensitizer). It is used in conjunction with molecular oxygen to elicit cell death (phototoxicity). PDT has an ability to kill microbial cells, including bacteria, fungi and viruses. Photodynamic therapy (PDT) requires the combination of a photosensitizer, light, and molecular oxygen to selectively target cells like tumor cells via cytotoxic activity (local effect). It has been known for some time that porphyrins and related compounds have the ability to selectively accumulate in tumor tissues, and to persist there for long periods of time. This property, along with the well-described photophysical and photosensitizing properties of porphyrin-type molecules have brought chemists to envision their potential use as adjuvants and sensitizers in a variety of medical applications, such as in photodynamic therapy (PDT).

As it is mentioned in the first paragraph, radiation of certain wavelengths, called ionizing radiation, has enough energy to damage DNA and cause cancer. In this research proposal, we plan to synthesize porphyrin molecules under solvent-free (or mixed solvent) conditions and to use these molecules for irradiating substances (gram positive and gram negative microorganisms (in vitro and in vivo), HeLa cells and etc). Why solvent-free conditions? First of all, solvent-free method is green method. Green chemical research into solvent-free synthetic methods has been explored over the last decade in an effort to reduce environmental impacts. Porphyrin synthesis is not sustainable as well, for instance, large use of (toxic) solvent, low yield and etc. are observed. This method has many advantages such as increased yield and tolerance of many functional groups.

The influence of porphyrins to the irradiated and un-irradiated substances will be investigated and the results will be compared for both methods. Radiation doses will be different (up to 500 KGy).

MASS SPECTROMETRY-BASED PROTEOMICS REVEALS ACETYLATION-DRIVEN ALTERATIONS IN PROTEOSTASIS AND METABOLISM AND IN LIVER DISEASES.

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Mass spectrometry-based proteomics is a powerful tool for the identification, quantification, and analysis of proteins, their post-translational modifications (PTMs), and turnover rates. The ^2H_2O-based metabolic labeling method developed by our group utilized deuterium-labeled water (^2H_2O) to study protein dynamics. In this approach, cells or organisms are exposed to deuterated water containing a stable hydrogen isotope, which is rapidly equilibrated with total body water and is incorporated into amino acids. Slow incorporation of ^2H-labeled amino acids during protein biosynthesis allows for the measurement of protein turnover rates by tracking deuterium incorporation over time using tandem mass spectrometry, enabling the quantification of protein synthesis and degradation rates.

We applied this method, combined with immunoaffinity enrichment and high-resolution mass spectrometry, to study the stability and turnover rates of acetylated proteins in rodents. Specifically, we assessed the effects of a high-fat diet (HFD) on acetylation and protein turnover in mouse models of high-fat diet (HFD)-induced nonalcoholic disease (NAFLD) and chronic alcohol exposure-induced alcoholic fatty liver diseases (ALD). Proteomic, acetylomic, and metabolic profiling were conducted to evaluate HFD and ethanol-induced alterations in hepatic metabolism, protein turnover, and acetylation.

We found that early-stage NAFLD is characterized by a coordinated increase in mitochondrial protein synthesis, coupled with restricted acetylation-induced degradation, resulting in enhanced mitochondrial turnover. Additionally, ethanol-induced alterations in acetylome dynamics modify hepatic substrate metabolism and contribute to liver injury through acetylation-dependent epigenetic changes and the regulation of metabolic enzymes. These findings underscore the utility of ^2H_2O-based metabolic labeling method to investigate the role of acetylation-related alterations in proteostasis and their contribution to the pathogenesis of NAFLD and ALD.

ENRICHMENT OF SLIGHTLY OIL-POLLUTED SOILS WITH ORGANIC FERTILIZERS

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The learn of our research was to study the effect of enriching soils with a moderate degree of oil pollution (2%) by adding dry cotton leaves and bentonite suspension (montmorillonite).

The proposed enrichment method requires careful grinding of dry cotton leaves in order to prevent the process of rotting, increase growth and strengthen the roots of wheat. Also, the bentonite used was pre-dispersed in order to enrich the soil with mineral additives and increase its fertility, while a colloidal suspension or gel is formed.

We first introduced the prepared organic fertilizer into ordinary soil and studied the efficiency of wheat plant growth.

The properties of bentonite, such as hydration, swelling, water absorption, viscosity, make it a valuable material for a wide range of applications. The formed tiny particles of bentonite contribute to a more uniform distribution of macro and microelements in the used volume of soil.

The crushed bentonite powder was mixed with water and subjected to ultrasonic treatment at a frequency of 20 kHz in an Ultrasonic Cell Crusher Noise Isolating Chamber, which produced bentonite particles of 20 nm in size.

As experimental data have shown, the use of dry cotton leaves as an organic fertilizer at a rate of 80.5-90 kg/ha, and as a mineral additive a dispersed suspension of bentonite in an amount of 40-50 kg/ha will enrich the soil and ensure more intensive growth of grain crops.

FUNCTIONALIZED GRAPHENE OXIDE NANOCOMPOSITES FOR AIR FILTRATION: TARGETING PESTICIDES, PCBS, AND PHENOLIC POLLUTANTS

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Effective air purification technologies are essential to mitigate hazardous organic pollutants, such as pesticides, polychlorinated biphenyls (PCBs), and phenolic compounds, which pose serious environmental and health risks. This study focuses on the synthesis and characterization of functionalized graphene oxide (GO) nanosheets modified with Schiff Base and reduced Schiff Base moieties, aiming to develop advanced materials for air filtration systems.

The functionalization of GO was achieved through covalent modification processes involving ester and amide bond formation, as well as epoxy ring opening. The modified GO nanosheets were extensively characterized using solid-state nuclear magnetic resonance (SSNMR), Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), thermogravimetric analysis (TGA), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). These analyses confirmed the successful incorporation of functional groups and structural enhancements.

The functionalized GO derivatives were evaluated for their adsorption capacity against key pollutants, including pesticides, PCBs, and phenols. The results revealed that the materials exhibit excellent adsorption performance due to their enhanced surface area, chemical reactivity, and three-dimensional structural features.

This study concludes that covalently functionalized GO nanosheets hold significant potential for integration into air filtration systems. These materials provide an innovative and efficient solution for the removal of hazardous organic compounds from air, contributing to the development of sustainable air treatment technologies.

ACTIVITY OF 3,4-DIHYDROCOUMARIN DERIVATIVE MOLECULES AGAINST PARKINSON'S DISEASE

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3,4-Dihydrocoumarin derivative molecules are attracting attention as promising chemical building blocks in the treatment of Parkinson's disease. Parkinson's disease is a neurodegenerative disorder characterized by degeneration of dopaminergic neurons, and new molecular approaches are an important need due to limited effective treatment options. 3,4-Dihydrocoumarin structures stand out with their effects on the inhibition of oxidative stress, reduction of neuroinflammation, and biochemical pathways that support dopamine production. In particular, the antioxidant properties of these derivatives, such as inhibition of monoamine oxidase-B (MAO-B) enzyme and neutralization of reactive oxygen species, offer potential biological effects that may reduce cellular damage in Parkinson's disease.

These molecules are also considered strong candidates for examining their neuroprotective effects with in silico approaches. Molecular docking studies show that 3,4-dihydrocoumarin derivatives interact with enzymes and receptors that play an important role in Parkinson's disease with high affinity. This feature emphasizes the potential of the molecules for therapeutic efficacy. At the same time, the lipophilic structure of these derivatives may offer pharmacokinetic advantages in the treatment of Parkinson's disease by increasing the ability to cross the blood-brain barrier. Experimental and theoretical studies indicate that 3,4-dihydrocoumarin derivative molecules may constitute a new treatment strategy that can be used to slow down the neurodegenerative processes associated with Parkinson's disease.

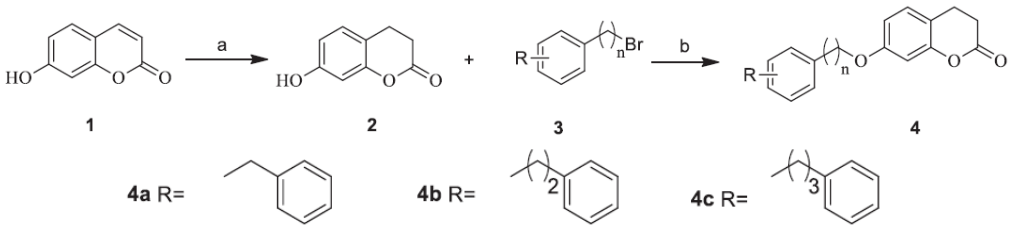

Figure 1. molecular structure of molecule

3,4-Dihydrocoumarin derivative molecules were synthesized from the above reaction and obtained in figure 1. Afterwards, optimized structures of 3,4-Dihydrocoumarin derivative molecules were obtained using various programs, these programs are Gaussian09 RevD.01 and GaussView 6.0. By using these programs, calculations were made in B3LYP, HF, and M06-2x methods with the 6-31++g(d,p) basis set. Finally, the activities of 3,4-Dihydrocoumarin derivative molecules molecules against Parkinson's disease proteins were investigated by molecular docking calculations.

ANTIBACTERIAL STUDIES OF NOVEL TYRAMINE-BASED AZOMETHINES

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The increase in the mortality rate associated with infectious diseases is directly related to microbes that exhibit multiple resistance to antibiotics. The main cause of this problem is the lack of effective treatments. Therefore, the development of new antimicrobial agents with novel and more efficient mechanisms of action is definitely an urgent medical need. Various classes of compounds are used to solve this issue, among which Schiff bases are one of the popular choices. Schiff base (also known as imine or azomethine) is a nitrogen analogue of an aldehyde or ketone in which the carbonyl group (C=O) has been replaced by an imine or azomethine group. They can be considered as some of the most widely used organic compounds. They are used as pigments and dyes, catalysts, intermediates in organic synthesis, and as polymer stabilisers. Along with it, Schiff bases have a wide range of biological activities, including antifungal, antibacterial, antimalarial, antiproliferative, anti-inflammatory, antiviral, and antipyretic properties. Imine or azomethine groups are present in various natural, natural-derived, and non-natural compounds. The imine group present in those compounds has been shown to be critical due to their biological activities.

Various investigations demonstrated that several natural, natural-derived, and non-natural Schiff bases contain fragments of various salicylaldehyde derivatives, such as vanillin, orthovanillin, halogenated and nitrated forms and so on.

From the other point of view, the amine fragment in the structure of Schiff base is also important from the point of biological activity, due to the fact that the nitrogen atom in the azomethine bond plays the role of Lewis base and by inhibiting various enzymes halt the development of microbe culture. Tyramine is a trace monoamine with sympathomimetic properties. It is naturally found in foods, plants, and animals. Various investigations demonstrated that tyramine has a high affinity for binding to various enzymes. It was also determined that tyramine-based azomethines inhibit the activity of various gram-positive and gram-negative bacteria, as well as fungi.

Taking into account all the above mentioned, it was decided to perform the synthesis of novel Schiff bases consisting of orthovanillin, 5-nitro salicylaldehyde and vanillin as an aldehyde fragment and tyramine as an amine fragment. The structure of the obtained molecules was determined by ^{1}H, ^{13}C NMR spectroscopy and mass spectrometry methods, as well as elemental analysis. The antimicrobial activity of the obtained compounds was studied on Escherichia coli, Staphylococcus aureus, Acinetobacter baumannii, Klebsiella pneumoniae and Candida albicans and the obtained results were compared with the results of pristine antibiotics. It was found that some synthesized agents were more active than antibiotic.

CONTENTS

Meneghetti F., Cazzaniga G., Mori M., Griego A., Scarpa E., Moschetti G., Stelitano G., Chiarelli L.R., Cocorullo M., Tresoldi A., Pini E., Batalha I.L., Battaglia G., Tuccinardi T., Rizzello L., Villa S

Towards the development of furan-based derivatives as a new class of salicylate synthase (MbtI) inhibitors with antimycobacterial activity 9

Shahverdiyeva K., Ismayilova S., Ismayilov V., Israyilova A., Demiralp M., Çetintaş H.

Novel chalcone synthesis using salicylaldehyde derivative and pentane-2,4-dione 10

Can F.

Novel therapy approaches to combat emerging multidrug-resistant pathogens . 11

Aliyev A., Baghirova A.

Advancing artificial heart valves: polyurethane nanocomposite membranes modified with graphene oxide and phenolic acids 12

Sayın K., Tüzün B., Keklikçioğlu Çakmak N., Ataseven H., Gezegen H., Taş A., Özkaraca M., Kanbur M., İnandıklıoğlu N., Görgülü A. O., Yalçın B.

The story of new HDAC1-3 inhibitors in gastric cancer treatment, from dream to reality: 360 molecules, one target 13

Alizadeh F., Huseynzada A., Israyilova A., Yolchuyeva U., Hasanova U., Gasimov E., Eyvazova G., Rzayev F., Isayev O., Ahmadova A., Aliyev E.

Synthesis of protected amide towards C(O)-N bond cleavage under catalyst-free condition 14

Tekerek B. S., İkizler B., Elalmis Y., Terzioğlu P., Özel C., Yücel S.

Comprehensive analysis of structural properties and *in vitro* bioactive performance in titanium-doped 45S5 bioglasses 15

Hasanova I., Hasanova U., Gasimov E., Rzayev F., Hajiyev E., Eyvazova G., Shaliyev M., Mehdiyeva A., Aliyeva N., Yusifov Y., Ismayilov H., Akhundzada H. V., Aghamaliyev Z., Hajiyeva S., Huseynova P.

Calcium carbonate and hydroxide nanoparticles for cement reinforcement 16

Mileva M.

The flower power of bulgarian roses – delicate perfume and natural medicine 17

Ismayilova S., Huseynzada A., Hasanova U., Gahramanova Z.

Synthesis of novel vitamin B6-based azomethines 18

Ataç N.

Impact of multi-disciplinary study model on infectious diseases 19

Guliyev R., Huseynzada A., Hasanova U., Jafarov Y.

Synthesis of novel salen-type azomethines 20

Demiralp M., Algherbawi A.A.K., Çetintaş H.İ.

Removal of Safranin O from water samples using plant-based biomass: Adsorption isotherms, kinetics, and thermodynamics studies 21

Malikova N., Hasanova I.

Synthesis and characterization of calcium aluminate nanoparticles for concrete reinforcement 22

Abzhanova Sh.A., Nadirova S.A.

Application of sustainable agriculture principles in the conditions of technological development of the agrarian sector of Kazakhstan 23

Hasanova S., Huseynzada A., Amiraslanov I., Chiragov F.

Synthesis and research of a new adsorbent based on cinnamic acid and graphene oxide 24

Kıska S., Sayın K.

Investigation of molecular properties of aminoborane dimers by computational chemistry methods 25

Shahverdiyeva K., Ismayilova S., Ismayilov V., Zarema G., Demiralp M., Çetintaş H.İ.

New chalcone synthesis with pentane-2,4-dione and salicylaldehyde derivative 27

Ersoy Omeroglu E.

Rational Use of Natural Resources: Example of Bioluminescent Imaging and Bioluminescent Biosensor 28

Aliyev E., Hasanova U., Amrahov N.

The effect of alginate-based hydrogel complexes on wheat (triticum durum) development 29

Ertaş A., Sayim F.

Invisible invaders of the gulf of Izmir, microplastics 30

Ibrahimli E., Hasanova U., Azizov A.

Design and analysis of novel supramolecular assemblies based on graphene oxide nanolayers and azomethines 31

Ustaoğlu B., Çetintaş H.İ.

Biosorption of Pb(II) from aqueous solution using *Echinophora sibthorpiana* biomass 32

Valiyeva A., Garayev E., Gasimov E., Rzayev F.

Toxic effects of *DATURA INNOXIA* MILL. light and electron microscopic study 33

Dimitrova L., Mileva M., Georgieva A., Tzvetanova E., Popova M., Bankova V., Najdenski H.

Redox-modulation capacity and phenotyping inhibitory potential of the *Pseudomonas aeruginosa* Las/RhI quorum sensing system by extracts of *Geum urbanum* L. roots and aerial parts 34

Yolchuyeva U., Abbaszade L., Abdulxaliqova C., Aydayev I., Novruzova A., Mammadov I., Zaid M., Eyvazova D., Muxtarzada N

Spectral study of the organic component of Azerbaijan's oil sands and the first attempt to obtain alternative fuel 35

Demircan N., Pinar B., Uzilday B., Uzilday R. O

The effects of ascorbic acid, DPI, and rotenone on ROS metabolism during halotropism in different *Arabidopsis thaliana* ecotypes and the extreme halophyte *schrenkiella parvula* 36

Bayramli O.

Investigation of the amount of chlorophyll in native and imported genotypes of soybeans *(Glycine Max).* 37

Agbektas T., Sönmez Gürer E.

Assessment of anticancer activity of *C. Orientalis* flower ethanol extract: molecular modulation of *PAX6* and *MDR (ABCB1)* in AGS and Hs-738.St/ Int cell lines 38

Khankishiyeva R., Mammadov A., Akhundzada H.V., Azizova A., Mammadova G., Salehov A.

Addressing global environmental issues through sustainable agricultural practices: the role of gamma-irradiated chitosan in crop production 39

Demir E., Sayın K.

Synthesis of new indenone derivative compounds and investigation of their VEGFR2 inhibitory properties using in silico methods 41

Kaya S., Erkan S.

Molecular insights into Platinum (IV) complexes: DFT analysis and docking studies for enhanced anticancer activity 42

Allahverdiyeva S., Amrahov N., Elshan A., Mammadov Z., Khudayev F., Mammadova A.

Effect of NO inductor on no and chlorophyll content of durum wheat (triticum durum) under drought and salinity stress 43

Özel C., Özarslan A. C., Yücel S.

Development of a polyethylene glycol(PEG)/glycerol-based injectable bone graft containing different sizes of 45S5 bioactive glass 44

Naghiyeva N., Rzayev F., Allahverdiyev R.

Antiparasitic effect of Fe_3O_4 nanoparticles. Light and electron microscopic study 45

Zontul C., Sönmez Gürer E.

Anticancer activities of *S. Rotundifolium* ethanol extract (aerial parts) and its impact on *KCNQ1OT1* and *MEG3* gene expression in HT-29 and CCD-18Co cell lines 46

Alizadeh F., Huseynzada A., Israyilova A., Yolchuyeva U., Hasanova U., Gasimov E., Eyvazova G., Rzayev F., Isayev O, Ahmadova A., Aliyev E.

Synthesis, characterization and biological activity studies on benzamide compound 47

Sayin K., Tüzün B., Keklikçioğlu Çakmak N., Nasif V., Güney E., Tüzün G.

Synthesis of acridine derivatives, DFT calculations and determination of their efficacy against TOPO I using in silico methods 49

Israfilova S., Huseynova Sh., Gasimov E.

Ultrastructural characteristics of blood vessels supplying the denticulate ligaments of the spinal cord 50

Gerasimova T., Gateva S., Jovtchev G., Angelova T., Topashka-Ancheva M., Dobreva A., Mileva M.

Rosa damascena Mill. essential oil: analysis of in vitro and in vivo genotoxic and cytotoxic potential employing three cytogenetic endpoints 51

Huseynova Mustafayeva U., Mammadova A.

Alternative splicing and the formation of identical isoforms in plant genomes 52

Yıldız S. D., Sayın K.

Synthesis of new nicotinamide-based carboxylic acid derivatives and ınvestigation of their poly (ADP-ribose) polymerase (PARP) ınhibitor properties by ın silico methods 53

Ismayilova S., Huseynzada A., Israyilova A., Hasanova U.

Promised anticancer compounds based on vitamin B6 54

Tüzün G., Sayın K.

Activity of pyrrolidinebenzenesulfonamides derivatives against carbonic anhydrase and acetylcholinesterase 55

Aliyeva S.

Study of rhodamine 6G and acridine yellow cationic dyes adsorption from aqueous solutions onto hybrid composites using three-parameter isotherm models 56

Özyavaş R., Sayın K.

Synthesis of diarylurea derivatives and ınvestigation of their ın silico activity against ınsulin-like growth factor (IGF) 57

Balayeva O., Guluzade N., Israfilli T., Azizov A., Alosmanov R.

Synthesis and investigation of fullerene and graphene oxide doped ZnAl-LDH/ PVS nanocomposites for photocatalytic applications 59

Özkan Güner K., Ayık Y., Özarslan A. C., Özel C., Kuçak M., Tekerek B. S., Yücel S.

Evaluation of boron and magnesium CO-DOPED SiO2–CaO–Na2O–P2O5, B2O3-MgO novel bioactive glass composition 60

Babayev A., Ismailova K., Gakhramanova Z., Sadiqova N., Yusubova N.

Enrichment of slightly oil-polluted soils with organic fertilizers 61

Baran Y.

Drug resistance in cancer 62

Khalilov R., Hajiyeva A., Mammadov Ch.

Impact of Fe_3O_4 nanoparticles on bioaccumulation, tissue structure and reproduction in Common carp (Cyprinus carpio Linnaeus, 1758) 63

Ayyubova G.

Mesenchymal stem cells reduce sustained microglial proliferation and brain inflammatory response 64

Gurbanov E., Mammadova Z., Vahidli A.

The role of medicinally significant toxic plants in strengthening the immune system against viruses during pandemics 65

Rahimov T., Mamedova N., Mustafaeva X.

Ethnobotanical study of the village of Bakikhanov (Baku, Azerbaijan Republic). 66

Javadzade A., Aghazada G., Amrahov N., Khalilov R., Gojayev A.

The study of quercetin glycosides and its derivatives' effects on angiotensin-converting enzyme through molecular docking and in silico analysis 68

Allahverdiyeva S., Isayev O., Rzayev F.

Effects of Fe3O4 nanoparticles on the liver of birds. light and electron microscopic study 69

Yusibov T., Amrahov N., Aliyev E., Mammadov Z.

Effect of IAA on NO and Peroxidase level in Agdash-3 (Gossypium hirsutum) cotton under drought stress 70

Mamedova N., Aliyeva H., Hajiyeva E.

Study of antibacterial properties of essential oil obtained from the leaves of savory (satureja hortensis l.) 71

Rustamova Sh., Cumshudlu K.

Effects of zinc ions on living organism 73

Alizadeh F., Huseynzada A., Israyilova A., Yolchuyeva U., Hasanova U., Gasimov E., Eyvazova G., Rzayev F., Isayev O., Ahmadova A., Aliyev E.

Site-Selective N-Boc Activation of secondary amide 74

Abiyev Y., Asadova K., Mammadova A.

Community-based tools for sustainable management of ethnobotanically rich forests 75

Ibrahimli E., Ismayilova L.

Synthesis and antibacterial potential of schiff bases containing β-lactam rings 76

Ismayilova S., Huseynzada A., Israyilova A., Hasanova U., Gahramanova Z.

Molecular docking and molecular dynamic simulations of vitamin B6 based novel compounds 77

Guliyev R., Huseynzada A., Hasanova U., Jafarov Y.

Synthesis of novel 2-hydroxybenzaldehyde-type azomethines 79

Alosmanov R.

Polymer brushes: design and applications 80

Shahverdiyeva K., Ismayilova S., Ismayilov V., Demiralp M., Çetintaş H.

Novel chalcone synthesis using salicylaldehyde derivative and 4-bromoacetophenone 80

Shafiyeva S., Ganbarov Kh., Teymur M.

Examination of effect of fluconazole electronically activated water against the fungus of genus Candida 81

Shahverdiyeva K., Ismayilova S., Ismayilov V., Demiralp M., Çetintaş H.

Synthesis of novel chalcone based on 4-bromoacetophenone and salicylaldehyde derivative 83

Malikova N., Gahramanova Z.

Synthesis and characterization of amino-functionalized graphene oxide 84

Shahverdiyeva K., Ismayilova S., Ismayilov V., Demiralp M., Çetintaş H.

Synthesis of novel chalcone based on pentane-2,4-dione and salicylaldehyde derivative 85

Mammadova A., Mammadova R.

Assessment of the health status of plants used in medicine 86

Heybatov A.

The role of ATP measurement in ensuring environmental safety and sustainable use of natural resources 87

Alizada Sh.

Evaluation of cotton varieties based on tolerance indices under salt stress conditions 88

Aliyeva G., Hasanova U., Bayram C., Gultekinoglu M.

Synthesis, characterization, and biological evaluation of novel benzo[b]thiophene derivatives 90

Yusifova J.

Study of metabolites of Ephedra distachya L. from the flora of Azerbaijan 91

Fataliyev E., Ahmadov I., Mamedov Z.

The study of nanoparticle - chlorophyll interaction by UV-vis spectroscopy 92

Abasova Kh., Gurbanli N., Jafarova S.

Investigation of the antibacterial activity of a novel tetrahydropyrimidine derivative against gram negative bacteria 93

Israyilova A., Buroni S., Chiarelli L.

Investigation of the antibacterial activity of a novel tetrahydropyrimidine derivative against staphylococcus aureus 94

Hasanova S., Huseynzada A, Israyilova A., Hasanova U.

Synthesis of a new biologically active heterocycle by Biginelli reaction 95

Hasanova S., Huseynzada A, Israyilova A., Hasanova U.

Synthesis and investigation of a newly modified biologically active dihydropyrimidine 96

Sayım F.

Ecotoxicity testing methods and models 97

Aliyev E., Jafarzade R., Valiyev A.

The effect of chitosan-based complexes on wheat (triticum durum) development 99

Akhundzada H.V., Khankishiyeva R., Salehov A.

Eco-friendly applications of novel hybrid materials 100

Gadimli A., Isayev J., Saracoglu I., Basaran A.

Comparative analysis of volatile oils in Gentiana L. species from Azerbaijan.....102

Hajiyeva S., Chandrasekhar S., Sundar Prakash P., Schmidt Th. L.

Modification of DNA based nanodiscs with amphiphilic polymers 103

Heybatov A.

Reuse of Treated Wastewater: Environmental and Economic Benefits 104

Akhundzada H.V., Mirzayev M., Akhundzada F.

Porphyrin synthesis under solvent-free condition and investigation of its influence in irradiated substances by photodynamic therapy method.....105

Aghayev M., Ilchenko S., Zhang G. F., Kasumov T.

Mass spectrometry-based proteomics reveals acetylation-driven alterations in proteostasis and metabolism and in liver diseases.....107

Babayev A., Lenchenkova L., Ismailova K., Gakhramanova Z., Sadiqova N., Yusubova N.

Enrichment of slightly oil-polluted soils with organic fertilizers.....108

Taghiyeva N., Hasanova U., Millet M.

Functionalized graphene oxide nanocomposites for air filtration: targeting pesticides, PCBs, and phenolic pollutants.....109

Tüzün G., Tüzün B.

Activity of 3,4-Dihydrocoumarin derivative molecules against Parkinson's disease.....110

Agalarzade M., Huseynzada A., Israyilova A., Hasanova U.

Antibacterial studies of novel tyramine-based azomethines..... 111

Printed: 04.07.2025
Volume 9,25 p.s. Amount 100

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33, Academician Z.Khalilov street, Baku, Azerbaijan
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