Virtual International Scientific Conference on

"Applications of Chemistry in Nanosciences and Biomaterials Engineering"

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27-29 November 2024

Book of Abstracts

APPLICATIONS OF CHEMISTRY IN NANOSCIENCES AND BIOMATERIALS ENGINEERING

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Program

The preliminary program will be published on the official webpage of the conference as well as on the webpage of AOSR on 20.11.2024, as well as in the TEAMS Class. The link for the TEAMS Class will be provided in due time, on or before 25.11.2024.

The topics for the conference include, but are not limited to:

- novel materials;
- surface chemistry;
- air and soil bioremediation;
- composite materials and biomaterials;
- applications of natural compounds and chemical products;
- nanomaterials and bionanomaterials for the controlled release of biologically active molecules;
- bionanoproducts for tissue engineering and regeneration;
- advanced techniques for material processing.

Deadlines:

1. Registration: 27.10.2024
2. Extended registration: 15.11.2024
3. Abstract submission: 31.10.2024
4. Extended Abstract Submission: 17.11.2024
5. Acceptance Notification: 20.11.2024
6. Final Program announcement: 25.06.2024
7. Conference: 27-29.06.2024

Registration:

Registration should be done using the link: https://nanobiomat.eu/registration/.

Registration is free for all students and postdoctoral researchers (or equivalent).

Abstract submission:

Abstract should be submitted in MS Word document using the link https://nanobiomat.eu/registration/ on or before 17.11.2024. The abstract should be 150–300 words and it must contain the title, authors, and their full affiliation.

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Program (GMT +2, Bucharest time)

	Wednesday; 27.11.2024	Thursday; 28.11.2024	Friday; 29.11.2024
8:00-8:30			
8:30-9:00			
9:00-9:30	Registration		
9:30-10:00			
10:00-10:30	**OPENING CEREMONY**		
10:30-11:00	2D transition metal carbides and nitrides (MXenes) and their biomedical applications. Yury GOGOTSI	Session III	Session VII
11:00-11:30	Harnessing Biogenic Nanomaterials for Sustainable Solutions: Innovations in Environmental Management, Healthcare, Industry, and Agriculture. Charles Oluwaseun ADETUNJI	Session IV	Session VIII
11:30-12:00	Additive Manufacturing of Bio-aerogels with StructureCorrelated Thermal, Mechanical, and Biological Properties. Shanyu ZHAO		
12:00-12:30	Processing and Design of Materials for Bone Tissue Engineering. Anton FICAI	Nanomaterials for the Regulation of Inflammation. Sergej TOMIC	Integrating environmental phyto-remediation with biomass valorization for the recovery of some critical metals and energy by phytomining. Maria GAVRILESCU
12:30-13:00	Q&A session	Intrinsically disordered peptides enhance regenerative capacities of bone composite xenografts. Havard J. HAUGEN	Hot Quantum Materials. Klaas-Jan TIELROOIJ
13:00-13:30	**Lunch Time**		**CLOSING CEREMONY**
13:30-14:00			
14:00-14:30			
14:30-15:00	Session I	Session V	Session VI
15:00-15:30			
15:30-16:00	Session II		
16:00-16:30			
16:30-17:00			
17:00-17:30	Poster Sessions I	Poster Sessions III	Poster Sessions IV
17:30-18:00	Poster Sessions II		

Wednesday, 27 November 2024

08:00-08:30		
08:30-09:00		
09:00-09:30	**Registration**	
09:30-10:00		
10:00-10:30	**OPENING CEREMONY** **Chair: Ecaterina ANDRONESCU** **LINK**	
10:30-11:00	**Plenary SESSION I. Advanced Functional Materials** **Chairs: Ridha DJELLABI; Anton FICAI** **LINK** *2D transition metal carbides and nitrides (MXenes) and their biomedical applications.* ***Yury GOGOTSI***	
11:00-11:30	*Harnessing Biogenic Nanomaterials for Sustainable Solutions: Innovations in Environmental Management, Healthcare, Industry, and Agriculture.* ***Charles Oluwaseun ADETUNJI***	
11:30-12:00	*Additive Manufacturing of Bio-aerogels with StructureCorrelated Thermal, Mechanical, and Biological Properties.* ***Shanyu ZHAO***	
12:00-12:30	*Processing and Design of Materials for Bone Tissue Engineering.* ***Anton FICAI***	
12:30-13:00	*Q&A session*	
13:00-13:30	**LUNCH BREAK**	
13:30-14:00		
14:00-14:30	**SESSION I. MATERIALS AND TECHNOLOGIES FOR CIRCULAR ECONOMY** **Chairs: Simina LAKATOS; Ovidiu OPREA** **LINK**	**SESSION II. TISSUE ENGINEERING AND REGENERATIVE MEDICINE** **Chairs: Christophe EGLES; Andreea-Teodora IACOB** **LINK**
14:30-18:00		
15:00-15:30		
15:30-16:00		
16:00-16:30		
16:30-17:00		
17:00-17:30	**Poster SESSION I** **Chairs: Denisa FICAI; Luigi CALABRESE** **LINK**	**Poster Session II** **Chairs: Vasile-Adrian SURDU; Sergej TOMIC** **LINK**
17:30-18:00		

Thursday, 28 November 2024		
9:30-10:00	**SESSION III. FOOD AND NATURAL COMPOUNDS FOR HEALTH** **Chairs: Anca MAZARE; Ioana DEMETRESCU** **LINK**	**SESSION IV. MATERIALS FOR ANTICORROSIVE AND ENVIRONMENTAL APPLICATIONS** **Chairs: Gianluca VISCUSI; Roxana PITICESCU** **LINK**
10:00-10:30		
10:30-11:00		
11:00-11:30		
11:30-12:00		
	PLENARY SESSION II. NANOBIOMATERIALS FOR HEALTH **Chairs: Jorg OPITZ; Liliana VERESTIUC** **LINK**	
12:00-12:30	*Nanomaterials for the Regulation of Inflammation.* ***Sergej TOMIC***	
12:30-13:00	*Intrinsically disordered peptides enhance the regenerative capacities of bone composite xenografts.* ***Havard J. HAUGEN***	
13:00-13:30	**LUNCH BREAK**	
13:30-14:00		

14:00-14:30 14:30-18:00 15:00-15:30 15:30-16:00 16:00-16:30 16:30-17:00	**SESSION V. MATERIALS WITH ANTIOXIDANT, ANTIMICROBIAL, AND ANTICANCER PROPERTIES** **Chairs: Oguzhan GUNDUZ; Andrei Victor SANDU** **LINK**	**SESSION VI. ADVANCED MATERIAL FOR SPECIFIC APPLICATIONS** **Chairs: Shanyu ZHAO; Victor FRUTH** **LINK**
17:00-17:30 17:30-18:00	**Poster Session III** **Chairs: Cem Bulent Ustundag; Irina FIERASCU** **LINK**	**Poster Session IV** **Chairs: Sergiu COSERI; Serguei SAVILOV** **LINK**

Friday, 29 November 2024		
9:30-10:00 10:00-10:30 10:30-11:00 11:00-11:30 11:30-13:00	**SESSION VII. SIMULATIONS, OPTIMIZATIONS AND USE OF ARTIFICIAL INTELLIGENCE IN MATERIALS PROCESSING AND DESIGN** **Chairs: Klaas-Jan TIELROOIJ; Graziella-Liana TURDEAN** **LINK**	**SESSION VIII. NATURAL, GREEN AND BIOMIMETIC MATERIALS** **Chairs: Charles Oluwaseun ADETUNJI; Mihaela DONI** **LINK**
13:00-13:30	**Plenary SESSION III. MATERIALS FOR QUANTUM AND ENVIRONMENTAL APPLICATIONS** **Chairs: Heiko FRANZ; Radu Claudiu FIERASCU** **LINK** *Integrating environmental phyto-remediation with biomass valorization for the recovery of some critical metals and energy by phytomining.* ***Maria GAVRILESCU***	
13:30-14:00	*Hot Quantum Materials.* ***Klaas-Jan TIELROOIJ***	
14:00-14:30	**CLOSING CEREMONY – LINK** **Chair: Ecaterina ANDRONESCU**	

Wednesday, 27 November 2024

09:00-10:00 – Registration

10:00-10:30 – OPENING CEREMONY – LINK

Chair: Ecaterina ANDRONESCU

Ecaterina ANDRONESCU – President of the Scientific Committee

Doru DELION – President of the Bucharest Branch of Academy or Romanian Scientists

Tudor PRISECARU – State Secretary of the Ministry of Research, Innovation and Digitization, President of the Senate of The National University of Science and Technology Politehnica Bucharest

10:30-13:00 – Plenary SESSION I. Advanced Functional Materials – LINK

Chairs: Ridha DJELLABI; Anton FICAI

10:30-11:00 2D transition metal carbides and nitrides (MXenes) and their biomedical applications. **Yury GOGOTSI**

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11:30-12:00 Additive Manufacturing of Bio-aerogels with StructureCorrelated Thermal, Mechanical, and Biological Properties. **Shanyu ZHAO**

12:00-12:30 Processing and Design of Materials for Bone Tissue Engineering. **Anton FICAI**

12:30-13:00 Q&A session

13:00-14:00 – LUNCH BREAK

14:00-17:00 – SESSION I. Materials, Technologies and Devices in the Context of Circular Economy – LINK

Chairs: Simina LAKATOS; Ovidiu OPREA

14:00-14:15 Ethanol photodegradation on noble metals-modified TiO_2 obtained by sol-gel method. **Alexandra Ilie**, Crina Anastasescu, Luminita Predoana, Jeanina Pandele-Cusu, Adriana Rusu, Silviu Preda, Daniela Culita, Ioan Balint, Maria Zaharescu

14:15-14:30 Development of cellulose-based textile materials with improved surface properties. **Şevval Kocaman**, Semra Unal, Mehmet Burçin Pişkin, Cem Bülent Üstündağ

14:30-14:45 Impact of Bistability in Silicon Oil-Dispersed Ferroelectric Liquid Crystal Emulsion Systems for Data Storage Applications. **Ashok Chaudhary**

14:45-15:00 Improvement of new potential biomaterials and their characterization using techniques such as microscopy, spectroscopy, electrochemistry, chromatography etc. **Radu Nartita**, Florentina Golgovici, Daniela Ionita, Ioana Demetrescu

15:00-15:15 Nanonization Stratagems for Improving Innovative Extraction and Size Reduction of Fastidious Biomaterial and Its Physico-Chemical Characterization. **Amutha K.,** Anitha C., Meena K., Thamizharasan

15:15-15:30 Three-dimensional Graphene Obtained by CVD Synthesis. **Cristina Antonela Banciu**, Ioana Ion, Delia Patroi, Gabriela Sbarcea, Virgil Marinescu, Marius Lungulescu, Adela Bara, Lucia Monica Veca, Florin Nastase, Anca Ionela Istrate

15:30-15:45 Nopal Cactus Mucilage as a Sustainable Corrosion Inhibitor for Bronze B66 in Saline Environments. **Malak Rehioui**, Hamid Erramli, Najat Hajjaji

15:45-16:00 Chitosan-based smart and versatile materials. **Raluca-Marieta Toma**, Ludmila Aricov, Anca-Ruxandra Leonties, Monica-Elisabeta Maxim and Aurica Precupas

16:00-16:15 Structural Insights into Wood Impregnation with Nanosilica Particles. **Diana Floriana Fundeanu (Tălau)**, Anton Ficai

16:15-16:30 From biomass to value-added materials: The relevance of biochar and hydrochar in bioremediation processes and circular economy framework. **Emanuel Gheorghița Armanu**, Irina Volf

16:30-16:45 Mechanical Properties of Poly(ethylene succinate) Thin Films Embedded with Chemically Synthesized Copper Oxide Nanoparticles. **Zoulikha Hafsi**, Yasmina Khane, Abdelhalim Zoukel

16:45-17:00 Effect of the lithium ions insertion on the physico-chemical characterizations of geopolymers. **Mouna Sellami**, Maud Barre, Mohamed Toumi

14:00-17:00 – SESSION II. TISSUE ENGINEERING AND REGENERATIVE MEDICINE – LINK

Chairs: Christophe EGLES; Andreea-Teodora IACOB

14:00-14:15 Dual-Responsive Hydrogel Biosensor Based on Hydroxyethyl Cellulose/Acrylamide-Nitrogen Doped Carbon Dots for Bacterial Detection. **Hebat-Allah S. Tohamy**

14:15-14:30 Production of chitosan-PVA coated vitamin E and ephedrine microparticles for the treatment of narcolepsy. **Asude Bilge Yakut**, Ayşe Betül Bingöl, Büşra Oktay, Cem Bülent Üstündağ

14:30-14:45 Ultrasound-assisted synthesis and characterization of hydroxyapatite/β-cyclodextrin composite as additive for tanning industry. **Elisa Dumbravă**, Ilaria Quaratesi, Petre Chipurici, Adrian Bercea, Yassin Zaki, Andrei Cucos, Miruna S. Stan, Genoveva Burca, Elena Badea

14:45-15:00 Assessment of Hyaluronic Acid and Melatonin's Efficacy on Bovine Tooth Remineralization: A Comparative in vitro Study with Well-Recognized Agents. **Aysenur Ertunc Demirci**, İbrahim Isildak

15:00-15:15 Fabrication and Characterization of 3D Printed SA/PVA/XG Composite for Wound Dressing Applications. **Emine Büşra Terzi**, Sümeyye Cesur, Oğuzhan Gündüz

15:15-15:30 Examination of the Effect of Electrospun Clay-Modified Polyvinyl Alcohol (PVA) Nanofibers Produced by Electrospinning on Wound Healing. **Sumeyye Kaplan**, Eslem Ekemen, Sumeyye Cesur, Oguzhan Gunduz

15:30-15:45 Simulation of dual loading of demineralized cancellous bone with active principles and bovine albumin. **Cobzac Vitalie**, Jian Mariana, Malcova Tatiana, Marițoi Tatiana, Plamadeală Svetlana, Nacu Viorel

15:45-16:00 Vascular grafts obtained through the 3D printing technique. **Ioana Ghiață**, Isabella Nacu, Liliana Vereștiuc

16:00-16:15 Fabrication and potential of chitosan-graphene oxide scaffolds in neuroregenerative medicine. **Andreea-Isabela Lazăr**, Alexa-Maria Croitoru, Ludmila Motelica, Ovidiu Oprea, Roxana-Doina Trușcă, Denisa Ficai, Anton Ficai

16:15-16:30 Multilayered Biofunctional Scaffold: An Integrated Approach for Innovative and Effective Treatment of Diabetic Wounds. **Shhd Saraj**, Kaan Daniş, Esra Yüca Yilmaz, Pelin Pelit Arayici, Selcen Ari Yuka, İlhan Onaran, Oguzhan Gunduz, Cem Bulent Ustundag

16:30-16:45 Utilization of 3D Printed Carboxymethyl Cellulose, Pectin, and Polyvinyl Alcohol-Based Bio-Scaffolds in Wound Healing. **Ogulcan Yuksekdanaci,** Fatih Mehmet Yildiz, Sumeyye Cesur, Oguzhan Gunduz

16:45-17:00 Characterization and Bioactivity Analysis of Doped and Loaded MCM-41 and MBGNs for Tissue Engineering. **Andreea-Luiza Mîrț**, Denisa Ficai, Andrada-Ioana Damian-Buda, Qaisar Nawaz, Gabriel Vasilievici, Anton Ficai, Aldo R. Boccaccini

17:00-18:00 – Poster Session I – LINK

Chairs: Denisa FICAI; Luigi CALABRESE

1. Effect of glucose, NaCl and urea on the interaction of quinizarin with SDS micelles. **Mirela Enache**, Ana Maria Toader, Izabella Dascalu, Petruta Oancea
2. Synthesis of (2E)-N-(4,6-dimethylpyrimidin-2-yl)-2-[1-(pyridin-2-yl) ethylidene] hydrazine-1-carbothioamide. **Andrei Neguță**, Roman Rusnac, Aurelian Gulea
3. Iron-containing catalysts obtained by sol-gel combustion synthesis for CO_2 hydrogenation. **Sergey V. Klokov**, Sergey I. Roslyakov
4. Influence of Temperature and Immersion Parameters on the Strength Rate of Calcium Phosphate-Based Scaffold. **Laura-Nicoleta Dragomir**, Ștefania Stoleriu, Georgeta Voicu, Andreea Cucuruz, Cristina-Daniela Ghițulică, Adrian-Ionuț Nicoară
5. Evaluation of scenarios for nutrient recovery from food waste and estimation of economic and environmental efficiency using Cost-Benefit Analysis. **Ungureanu-Comăniță Elena-Diana**, Țâbuleac Raluca Maria, Oprea Paula Sanzaiana, Cosbuc Ersilia, Gavrilescu Maria
6. Antimicrobial Packaging Films Based on Cellulose with Food Additives. **Gabriela Petrișor**, Ludmila Motelica, Denisa Ficai, Ovidiu Oprea, Anton Ficai, Roxana Trușcă, Ecaterina Andronescu, Ariana Hudiță and Alina Holban
7. Zn(II), {Zn(II)Au(I)}, and {Zn(II)Ag(I)} complexes with Schiff base ligands: promising antitumor agents against breast and cervical cancer cells. **Daniela C. Culita,** Tania Zhivkova, Abedulkadir Abudalleh, Lora Dyakova, Teodora Mocanu, Augustin M. Madalan, Milena Georgieva, George Miloshev, Gabriela Marinescu, Radostina Alexandrova
8. Synthesis and characterization of beta-TCP doped with gallium. **Ioana-Sandra Serdaru**, Georgeta Voicu, Adrian-Ionut Nicoara, Laura- Nicoleta Dragomir
9. Phenoxypicramide Rearrangement as Phenoxazine Derivative. **Rodica-Daniela Baratoiu-Carpen**, Elena-Nusa Hristea, Petre Ionita
10. Investigating of toxicity of extracts from vegetative organs of the species Bryophyllum pinnatum (Crassulaceae). Alice Maria Moise, Emanuela Gheorghita, Robert Ancuceanu, Mihaela Dinu, Marilena-Viorica Hovanet, **Cristina-Silvia Stoicescu**, Ioana-Leontina Gheorghe, Dana-Andreea Neacsu, Florinela Sirbu, Adriana-Iuliana Anghel
11. Functionalized Hydroxyapatite Coatings by MAPLE: A Novel Approach in Bone Tissue Engineering. **Diana-Elena Radulescu**, Bogdan Stefan Vasile, Ionela Andreea Neacsu, Ecaterina Andronescu
12. Green Synthesis of Zinc, Magnesium, and Copper Oxide Nanoparticles Using Orange Peel Extract. **Denisa-Maria Radulescu**, Ionela Andreea Neacsu, Bodgan Stefan Vasile, Ecaterina Andronescu

17:00-18:00 – Poster Session II – LINK

Chairs: Vasile-Adrian SURDU; Sergej TOMIC

1. Acoustic and Optical Analysis of Polyvinylpyrrolidone-K60 in Ethanol/Water Binary Mixtures. Applications in the synthesis of nanoparticles. **Monica Maria Mincu**, Florinela Sirbu, Dana Dragoescu, Cristina-Silvia Stoicescu, Ion Ion and Alina Catrinel Ion
2. The influence of e-beam irradiation on polyaniline film used for gas sensing applications. **Ana-Maria Popa**, Andrei Stochioiu, Luiza-Izabela Toderaşcu, Oana Gherasim, Vlad-Andrei Antohe, Elena Mănăilă, Gabriela Crăciun, Gabriel Socol and Iulia Antohe
3. Sensitive detection of ethanol in aqueous solutions using a plasmonic sensor. **Andreea Ionescu**, Ana-Maria Popa, Felicia Iacob, Vlad-Andrei Antohe, Gabriel Socol and Iulia Antohe
4. Comparative Analysis of Cerium-Doped vs Cerium-Strontium Co-Doped Bioactive Glass: Improved Properties and Prospective Applications. **Cezara-Marina Bolocan**, Alexandru Anghel, Vasile Adrian Surdu, Roxana Trusca, Anton Ficai, Ecaterina Andronescu
5. Prospects for the use of carbon sorbent obtained from rice husk for the sorption of petroleum volatile organic compounds with their subsequent analysis by gas chromatography-mass spectrometry with thermal desorption. **Valentina Levkina**, Anastasia Antonova, Alexander Popov, Roman Novotortsev, Sergey Savilov
6. Performant biofunctional dressings based on Aloe vera hydrogels. **Mariana Chelu**, Monica Popa, Adina M. Musuc, José M. Calderón Moreno
7. The Use of Nanoparticles in Targeting Cancer Cells and Reducing the Side Effects of Chemotherapy. **Natalia Guzgan**, Pavel Topală, Adrian Surdu, Andrei Păduraru, Ecaterina Andronescu.
8. Cobalt Aluminate Nanoparticles Obtained Through a Soft Chemistry Route Using Mentha Leaves Extract. **Dana Gingașu**, Adelina-Carmen Ianculescu, Ovidiu Oprea, Simona Somacescu, Daniela C. Culita, Gabriela Marinescu, Jose Maria Calderon Moreno, Bogdan Stefan Vasile, Silviu Preda, Vasile-Adrian Surdu
9. A bioactive tetraaza macrocyclic complex of Co(III) targets the M2 parallel G-quadruplex DNA structure: CD spectroscopic studies. **Elena Gorincioi**, Vasile Lozovan, Alic Barba, Alexandru Rotaru, Natalia Chiselita, Oleg Chiselita, Elena Tofan, Ion Bulhac
10. Sodium lignosulfonate-derived porous carbons for application in energy storage and accumulation devices. **Elizaveta V**. **Sivenkova**, Serguei V. Savilov, Stepan Yu Kupreenko
11. Characterization of Rare Earth-Doped Hydroxyapatite: Structural and Morphological Analysis Using SEM, TEM, and XRD Techniques; **Diana G. Paduraru (Filip)**, Andrei V. Paduraru, Ecaterina Andronescu, Bogdan S. Vasile, Roxana D. Trusca
12. Fight Cavities: Nano Natural Agents. Taha Kaan Alkaya, Zeynep Imge Okuyan, **Ozge Karaer**

Thursday, 28 November 2024

09:30-12:00 – SESSION III. Food and Natural Compounds for Health – LINK

Chairs: Anca MAZARE; Ioana DEMETRESCU

09:30-09:45 Production and Characterization of Apitherapy-Based Wound Dress. **Cihan Atmaca**, Cem Bülent Ustundag, Azime Erarslan

09:45-10:00 Production and Characterization of Calendula officinalis Extract Loaded Nanofibers. **Ebrar Ece Donmez**, Betul Kafiye Koc, Sumeyye Cesur, Oguzhan Gunduz

10:00-10:15 Nanocomposite Films Incorporating Amla Extract, AgNP, Cu-MOF for quality enhancement of Indian Cheese. **Pir Mohammad Junaid**, Mohammad Zia-ul-haq, Sadaf Zaidi

10:15-10:30 Human Food Chain Routed Micro /Nano Plastic Particles and their Jeopardies Assessment. **Thamizharasan S,** Hemalatha M.S, Priya G

10:30-10:45 Advancements in Biodegradable Packaging with Natural Extracts: Emerging Perspectives on Food Safety Applications. **Madalina-Casandra Covoran**, Adina Magdalena Musuc

10:45-11:00 Circular economy principles applied in the hospitality industry to reduce food waste. **Raluca-Maria Țâbuleac**, Elena Diana Ungureanu Comăniță, Ersilia Lazăr Cosbuc, Isabela-Maria Simion, Maria Gavrilescu

11:00-11:15 Nutritional Profile, Fatty Acid Composition, Mineral Constituents, and Acute Toxicological Assessment of the flesh of H. aspersa Müller. **Marouane Aouji**, Malak Zirari, Amine Rkhaila, Bouchra Bouhaddioui, Rachid Bengueddour

11:15-11:30 Moringa Tree: A Natural Treasure for Nutritional and Industrial Applications. **Sunita Singh**, Avanish Chandra Sharma

11:30-11:45 Impact of Gallic Acid in Wastewater on Water Quality and Human Health: Chemical Mechanisms and Health Risks. **Larisa Mocanu**, Maria Gonta, Elizaveta Leontev

11:45-12:05 Synthetic and bionanocomposite coating for fruits and vegetables. **Rupak Kumar**

09:30-12:00 – SESSION IV. Materials for Anticorrosive and Environmental – LINK

Chairs: Gianluca VISCUSI; Roxana PITICESCU

09:30-09:45 Remediation of Zinc-polluted sites using mustard crops. **Mirela Cismasu (Enache)**, Ioana-Alexandra Ciocodei, Andrada-Cristina Ciucu

09:45-10:00 Exploring the Adsorption Properties of Modified Abies marocana Trab. needles for Methylene Blue Dye Removal. **Malak Zirari**, Marouane Aouji, Driss Hmouni, Nouredine El Mejdoub

10:00-10:15 Hybrid hydrogels based on PVA matrix for water remediation. **Ioana Ion**, Ciprian Mihai Mitu, Emanuel Virgil Marinescu, Cristina Antoanela Banciu, Alina Rucsandra Caramitu, Nicoleta Oana Nicula

10:15-10:30 Substituent Effect on Pyran-Pyrazole as Organic Inhibitors in Aggressive Medium: Experimental and Theoretical Studies. **Fatine El Farhani**, Ouakki Moussa, Benzekri Zakaria, Boukhris Said, Zouhair Elfakir, Said Bouzakraoui, Mohamed Ebn Touhami

10:30-10:45 Assessment of Copper Corrosion Resistance in 0.5M H_2SO_4: A Comparative Investigation Using Extracts from Two Moroccan Plants. **Mzioud Khaoula**, Habsaoui Amar, Rached Sara, Kharbouch Otmane, Ouakki Moussa, Ebn Touhami Mohamed

10:45-11:00 Sustainable Corrosion Inhibition of Carbon Steel in NaCl Solution Using Calcium-Cobalt Phosphate. **Nouhaila Ferraa**, Moussa Ouakki, Mohammed Cherkaoui, Mounia Bennani Ziatni

11:00-11:15 The anticorrosive capacity of Mentha pulegium L., against mild steel in sulfuric environment. **Sarah Rached**, Khaoula Mzioud, Otmane Kharbouch, Amar Habsaoui, Mohamed Ebn Touhami

11:15-11:30 Adsorption of Organic Contaminants on Sorbents Derived from Rice Husk Ash. **Sergei S. Reshetko**, Roman Yu. Novotortsev, Serguei V. Savilov

11:30-11:50 The Myth of Carbon Uptake from Environment on Ti and Anodic TiO_2 Surfaces. **Anca Mazăre**

11:50-12:10 Design of electrospun N-doped carbon dots/cellulose acetate system as efficient adsorbent of toxic dyes from contaminated waters. **Gianluca Viscusi**, Ștefania Mottola, Hebat-Allah S. Tohamy, Mohamed El-Sakhawy, Giuliana Gorrasi, Iolanda De Marco

12:00-13:00 – Plenary SESSION II. NanoBioMaterials for Health – LINK

Chairs: Jorg OPITZ; Liliana VERESTIUC

12:00-12:30 Nanomaterials for the Regulation of Inflammation. **Sergej TOMIC**

12:30-13:00 Intrinsically disordered peptides enhance regenerative capacities of bone composite xenografts. **Havard J. HAUGEN**

13:00-14:00 – LUNCH BREAK

14:00-17:00 – SESSION V. Materials with antioxidant, antimicrobial, and anticancer properties – LINK

Chairs: Oguzhan GUNDUZ; Andrei Victor SANDU

14:00-14:15 Dual-Layer Tissue Scaffold with Antibacterial Properties: Mechanical Support and Enhanced Tissue Regeneration for Advanced Wound Dressings. **Irem Aydos**, Sena Su Torun, Sevval Gunes, Sibel Daglılar, Eray Altan, Oguzhan Gunduz

14:15-14:30 A Tissue Scaffold Enriched with Cisplatin and Cranberry Plant in GelMA/Hap for Bone Cancer. **Aysegul Tiryaki**, Musa Ayran, Yeliz Göyük, Elif Kaya, Tubanur Avcı, Gulgun Tınaz, Oguzhan Gunduz, Ayse Ceren Calikoglu Koyuncu

14:30-14:45 Synthesis and Characterization of Graphene Oxide-Based Anticancer Drug Combination Functionalized with Folic Acid as a NanoCarrier for Methotrexate Targeted Delivery. **Reyhan Yanıkoğlu**, Canan Yağmur Karakaş, Mert Akın İnsel, Fatih Çiftçi, Cem Bülent Ustündağ

14:45-15:00 Treating Vaginal Yeast Infections with 3D Printing-Based Agents. **Fatih Mehmet Yildiz,** Melek Beyza Reyhanoğlu, Aysu Sarikaya Yasar, Sümeyye Cesur, Oğuzhan Gündüz

15:00-15:15 The Use of Bacterial Cellulose Coated with Salvia officinalis (Sage) Essential Oil in Wound Dressing Applications. **Hatice Simge Ozturk**, Azime Erarslan, Ahmet Kati

15:15-15:30 Nanoparticle-Based Drug Delivery Systems for Targeted Cancer Therapy. Rajesh Kumar Sharma, Jyoti Pandey, Deep Narayan Maurya, **Neelam Pawar**, Niranjan Babu Mudduluru, Revan Karodi, Arun Sharma, Archana Shaha

15:30-15:45 Synthesis, Antibacterial, Antiviral Study of Novel Schiff bases and their Vanadium complexes. **Khadija Khaldoune**, Ali Hasnaoui, Meriem Rafia, Naima Fdil, Mustapha Ait Ali

15:45-16:00 Evaluation of Antimicrobial and Antitumor Activities of Functionalized Nanostructures. **Ștefan-Alexandru Gaftonianu**, Carmen Chifiriuc, Ecaterina Andronescu

16:00-16:15 Fe-Cr-Nb-B Magnetic Nanoparticles: A Promising Tool for Targeted Cancer Cell Destruction. **Anca Emanuela Minuti**, Cristina Stavila, Horia Chiriac, Nicoleta Lupu

16:15-16:30 Design and Fabrication of a 3D-Printed Microneedle Bilayer Patch for the Treatment of Non-Melanoma Cancer. **Louna Karzoun**, Hilal Yilmaz, Yagmur Kazancıoglu, Esra Yuca Yilmaz, Cem Bulent Ustundag, Oguzhan Gunduz

16:30-16:45 Synthesis, spectral analysis and molecular docking of N-(prop-2-en-1-yl)-2-[4-(2,6,6 trimethylcyclohex-1-en-1-yl)but-3-en-2-ylidene]hydrazine-1-carbothioamide with anticancer potential. **Iana Stoica**, Andrei Ciursin, Roman Rusnac

16:45-17:00 Optimization of Magnesium Phosphate Cements for Medical Applications: Influence of Mg/P and P/L Ratios. **Anna Melnyk**, Magdalena Górecka, Aleksandra Mielewczyk-Gryń, Anna Ronowska, Marcin Wekwejt

14:00-17:00 – SESSION VI. ADVANCED MATERIAL FOR SPECIFIC APPLICATIONS – LINK

Chairs: Shanyu ZHAO; Victor FRUTH

14:00-14:15 Comparative Study on the Synthesis of Yttrium Aluminum Granate for Composite Scintillators. **Adrian Moraru**, Vladimir Lucian Ene, Cristina Constanța Gheorgiu, Adrian Ionuț Nicoară

14:15-14:30 Enhanced Photocatalytic Degradation of Azo Dye with ZnO Nanoparticles under Visible Light. Phytotoxicity Evaluation on a Common Plant Species. **Maria Paiu**, Lidia Favier, Doina Lutic, Raluca-Maria Hlihor, Véronique Alonzo, Maria Gavrilescu

14:30-14:45 New Insights into the Cytotoxicity and Biocompatibility of Three Types of Endodontic Materials – A Comparative Pilot Study. **Alexandra Popa**, Ecaterina Andronescu, Alexandra Ripszky, Bianca Voicu-Balasea, Florentina Duica, Mirela Sirbu, Marina Melescanu Imre, Silviu Mirel Pituru

14:45-15:00 Transport properties of ferrocene-based ionic liquid solution in acetonitrile. **Ivan Kozhatkin,** Ekaterina Arkhipova, Mikhail Levin, Anton Ivanov

15:00-15:15 Gold and zinc oxide nanocomposites for enhanced detection by Raman spectroscopy. **Andrei Matei**, Andrei Giulești, Sorin Ciucă, Iryna Makarchuk, Céline Keifer, Gregory Barbillon, Anne Carton, Benoit Pichon

15:15-15:30 Next-Generation Intumescent Coatings: Enhancing Fire Resistance in Steel Structures. **Paul Valentin Lovin**, Ana-Maria Albu, Iulia Neblea

15:30-15:45 Production and Characterization of Wound Dressings for Burn Treatment. **Haya Akkad**, Azime Erarslan, Esma Özerol

15:45-16:00 Functionalization of olefinic himachalene derivatives: Synthesis of novel functionalized sesquiterpenes. **Issam Louchachha**, Abdelmajid Faris, Youssef Edder, Brahim Boualy, Abdallah Karim, Mustapha Ait Ali

16:00-16:15 Covalently cross-linked carbon nanostructures: nanotubes/few-layer graphene nanoflakes hybrids. **Sergey Yakovlev**, DmitryStolbov, Eugenia Suslova, Serguei Savilov

16:15-16:30 The potential of nanotechnology and biomaterial in Alzheimer disease. **Reem Mohamednur**, Sevim Işık

16:30-16:45 Co-encapsulation of lipophilic APIs into niosomal carriers for antidiabetic therapy using thin film hydration method. **Andra Ababei-Bobu**, Florentina Geanina Lupașcu, Alexandru Sava, Ioana-Andreea Turin-Movilean, Oana Maria Ionescu, Mariana Pinteala, Lenuța Profire

16:45-17:00 Synthesis and analysis of 3-amino-5-(2-methylpropyl)-2-sulfanylideneimidazolidin-4-one based on the heterocyclization reaction. **Aliona Pîntea**, Roman Rusnac, Aurelian Gulea

17:00-18:00 – Poster Session III – LINK

Chairs: Cem Bulent Ustundag; Irina FIERASCU

1. Sustainable Fabrication of Zinc Oxide Nanoparticles Incorporated into Sodium Alginate beads for Controlled-Release Biofertilizers. **Yasmina Khane**, Zoulikha Hafsi, Djaber Aouf, Fares Fenniche, Sofiane Khane, Abdelhalim Zoukel
2. Exploring the Antibacterial Activity of Mixed-ligand Copper(II) Coordination Compounds with N-(4-methoxyphenyl)-2-oxopropanamide 4-allylthiosemicarbazone. **Ianina Graur**, Vasilii Graur, Irina Usataia, Victor Tsapkov, Carolina Lozan-Tirsu, Greta Balan, Aurelian Gulea
3. Eco-Friendly Silver-Modified Clay: Combating ISO SS Bacteria and Enhancing Malachite Green Dye Oxidation. **Mirila Diana-Carmen**, Rosu Ana-Maria, Georgescu Ana-Maria, Nedeff Florin-Marian, Jinescu Cosmin, Nistor Ileana-Denisa
4. An investigative study of chemistry and Antimicrobial activity of Moringa oleifera seeds ethanol extract. **Avanish Chandra Sharma**, Sunita Singh
5. Construction of a 3D Brain Model. **Ekin Erdogan**, Damla Arslantunali Sahin, Sreeparna Banerjee, Vasif Hasirci
6. Evaluation of Haloxylon scoparium extract as a green antioxidant and corrosion inhibitor for ordinary steel in 1M HCl medium. **Sara Haida**, Moussa Ouakki, Mouhsine Galai, Mohamed Allaoui, Khaoula Mzioud, Hayat Elwardani, Sara Rached, Abdelaziz Ramadane KRIBII, and Abderahim KRIBII
7. Study of Anticorrosive Properties of Thin Films in Acid Media**. Oana Cătălina Mocioiu**, Irina Atkinson, Raul Augustin Mitran, Cosmin Iulian Codrea, Veronica Bratan, Ludmilla Aricov, Nicoleta Vitan, Ana-Maria Mocioiu

8. TiO_2 − Supported Pd, Ag and Pd-Ag Nanoparticles: Preparation, Characterization and Photocatalytic H2 Evolution from Water Splitting. **Anca Vasile**, Florica Papa, Gianina Dobrescu, Veronica Bratan, Monica Pavel, Razvan-Nicolae State, Ioan Balint
9. The Role of the Polyphenols in Developing Coated Stents. **Ludmila Motelica**, Angela Spoială, Denisa Ficai, Ovidiu Oprea, Anton Ficai
10. Synthesis and in vitro evaluation of bioactive composites for bone tissue engineering. **Andrei-Alexandru Ivu**, Claudia-Narcisa Stefanoaia, Liliana Verestiuc, Florina Daniela Cojocaru
11. Decorative Tiles. Symbolism, technical and chromatic problems. **Mădălina-Oana Mihăilă**, Ecaterina Andronescu, Denisa Ficai, Oana Damian, Bogdan Ștefan Vasile
12. Innovative Liquid Crystalline Nanocoatings for Combating Implant Related Infections. **Seref Akay**, Oana Ciofu, Anan Yaghmur
13. A binary dumbbell visible-light-driven photocatalyst for simultaneous hydrogen production with the selective oxidation of benzyl alcohol to benzaldehyde. **Muhammad Tayyab**, Seemal Mansoor, Zeeshan Akmal, Mazhar Khan, Liang Zhou, Juying Lei, Jinlong Zhang.

17:00-18:00 – Poster Session IV − LINK

Chairs: Serguei SAVILOV, Sergiu COSERI

1. Magnetic bioactive glass: synthesis, characterization and in-vitro bioactivity evaluation. **Marian Rașcov**, Anton Ficai, Ovidiu-Cristian Oprea, Otilia-Ruxandra Vasile, Ecaterina Andronescu
2. Evaluation of Hyper-crosslinked Polystyrene Macroporous Resin on azo dye removal studies. **Nicoleta Mirela Marin,** Luoana Florentina Pascu, Gheorghe Cristian Serbanescu
3. A new application of polydivinylbenzene macroporous resin for Acid Orange 10 removal from aqueous solutions. **Nicoleta Mirela Marin**, Luoana Florentina Pascu, Gheorghe Cristian Serbanescu
4. Novel synthetic approach for 4-carboxyphenoxy and 4-fluorophenoxy tetrasubstituted palladium (II) phthalocyanines. **Valeria A. Kirillova**, Yana B. Platonova
5. Dendritic Mesoporous Silica Magnetic Core-Shell Nanoparticles used as a drug delivery system. **D. A. Vasile**, L. Motelica, O. Oprea, D. Ficai, A. Ficai
6. Biomaterials for Bone substitutes synthesized from organic waste. **Geanina Bușcă**, Adrian Surdu, Roxana Trușcă, Ludmila Motelica, Anton Ficai
7. Materials with applications in dye degradation. **Ana-Maria Fulgheci**, Roxana Trușcă, Ludmila Motelica, Adrian Surdu, Anton Ficai
8. Copper recovery from mine water through adsorption using clinoptilolite. **Ana-Maria Turculeț**, Anton Ficai
9. Oregano Essential Oil. **Marius Vasile Bârdan**

10. Fabrication of Electrospun Polylactic acid/Polyhydroxybutyrate/Silk Fibroin Nanofibers to Obtain Retinal Nerve Fiber Layer and Its Application for Retinal Diseases. **Sureyya Elif Çelik**, Ayse Ceren Calıkoglu Koyuncu-Songul Ulag-Oguzhan Gündüz
11. Combining Spectral Methods, Acid-Base Titrations and Computational Methods for Elucidation of Metal Binding Mechanisms on Activated Carbons. **Irina Ceban**, Amelia Bocirnea, Iolanta Balan, Raisa Nastas
12. Dielectric Spectroscopy of Melt-Mixed Epoxy resin and Pyrolytically Stripped Carbon Nanofiber Composites. **R. Belhimria**, N. Aribou, A. J. Paleo, M.E. Achour
13. Improving the optical properties of MoO_3 for Electrochromic application. **Sagir Ziya'ulhaq**, T.H. Darma, Abdu Y., M.D. Nurhafizah

Friday, 29 November 2024

09:30-13:00 – SESSION VII. SIMULATIONS, OPTIMIZATIONS AND USE OF ARTIFICIAL INTELLIGENCE IN MATERIALS PROCESSING AND DESIGN – LINK

Chairs: Klaas-Jan TIELROOIJ; Graziella-Liana TURDEAN

09:30-09:45 The effect of cellulose nanofibers concentration on the behaviour of nanoemulsions. **Gabriela-Mădălina Oprică**, Cătălina-Diana Uşurelu, Adriana Nicoleta Frone, Cristina Firincă, Cristian-Andi Nicolae, Radu Claudiu Fierăscu, Denis Mihaela Panaitescu

09:45-10:00 Design of a PVA-Based Nanofiber Wound Dressing Containing Silver Nanoparticles Reduced by Aloe Vera to Accelerate Healing in Diabetic Foot Ulcers. **Dilek Aygun**, Cem Bulent Ustundag, Azime Erarslan, Ayşe Betul Bingol, Cihan Atmaca, Alpay Kose

10:00-10:15 The capabilities of cerium oxide in general and dental treatment. **Cirică Eric-Cristian**, Ecaterina Andronescu, Anton Ficai, Ovidiu Oprea, Lucian-Toma Ciocan

10:15-10:30 Design and Production of 3D Printed Tissue Scaffold for Use in Skin Tissue Engineering Applications. **Miray İş**, Azime Erarslan, Cem Bülent Üstündağ

10:30-10:45 Optimization studies of rGO-FeO-MnO_2-ppy as electrode materials for asymmetric supercapacitors. **Balarabe El-yaqub**, Mohd Haniff Wahid, Zulkarnain Zainal, Abdul Halim Abdullah, Wan Azlina Wan Ab Karim Ghani

10:45-11:00 Valuable and Versatile Polymeric Building Blocks: Foundations for Innovative Materials. **Alecu Alin Ionuț**, Albu Ana Maria

11:00-11:15 The Perspectives on the Use of Augmented Reality in Oncology Through the 3D-Printing Technologies. **Valic Eugeniu**, Valic Vladimir, Ciobanu Daniela, Șchiopu Victor

11:15-11:30 Data Analysis for Nanoscience Research. **Sabirin Iman Omar**

11:30-11:45 Interwoven Architectural Complexity in Ni(II) Ion-Based 3D MOF Using Bipyridine and Tetrabenzenecarboxylic Acid: Adsorption Insights in Highly Efficient Iodine and Cationic Dye Capture. **Shaikh Arfa Akmal**, Mohd Khalid.

11:45-12:05 Possibilities for AI. **Grigore Psenovschi**

12:05-12:25 Transparent Coatings with Anticorrosive and Hydrophobic Properties Used for Self-Cleaning of Photovoltaic Solar Panels. **Oana Cătălina Mocioiu**

12:25-12:45 ClO_2 as a Versatile Preservative: Mechanisms, Generation Methods, and Potential Applications for Fruit and Vegetable Preservation. **Siddharth Thakur**

12:45-13:00 General Discussions

09:30-13:00 – SESSION VIII. NATURAL, GREEN AND BIOMIMETIC MATERIALS – LINK

Chairs: Charles Oluwaseun ADETUNJI; Mihaela DONI

09:30-09:45 The Effect of Infill Percentage on 3D Printed PVA Substrates: Controlled Gallic Acid Release Study. **Sevil Cikrikci Erunsal**, Erinc Bahcegul, Gokce Bahcegul

09:45-10:00 Production and Characterization of Valproic Acid Loaded GelMA/Sodium Alginate 3D Scaffolds for Epilepsy Research. **Zeynep Sünbül**, Canan Bozyokuş, Dilruba Baykara, Cem Bülent Üstündağ, Oğuzhan Gündüz

10:00-10:15 Collagen-based composite biomaterial for medical application. **Jian Mariana**, Mostovei Andrei, Motelica Ludmila, Nacu Ana Maria, Oprea Cristian Ovidiu, Solomon Oleg, Cobzac Vitalie, Ficai Denisa, Ficai Anton, Nacu Viorel

10:15-11:00 Silver Nanoparticles mediated by Daucus carota L. Extract via Facile Green Synthesis against Brain cell lines. **Ikechukwu P. Ejidike**

11:00-11:15 Production and Characterization of Caffeic Acid-Loaded Wound Dressings Using 3D Printing Technique. **Kevser Duman**, Sena Celik, Zekiye Akdag, Muhammad Khaqan Zia, Asima Asghar, Tayyaba Bari, Songul Ulag, Canan Dogan, Fakhera Ikram, Oguzhan Gunduz

11:15-11:30 Gold Nanoparticles Synthesized using Plant Extracts for the Specific Detection of Various Analytes. **Melinda David**, Teodor A. Enache, Monica Florescu, Camelia Bala

11:30-11:45 Nanostructured Multicomponent Bioinks with Synergistic Nanodiamond and Magnesium-Doped Hydroxyapatite for Enhanced Bone Tissue Engineering. **Carmen-Valentina Nicolae**, Masoumeh Jahani Kadousaraei, Mehmet Serhat Aydin, Shuntaro Yamada, Niyaz Al-Sharabi, Ahmad Rashad, Elisabetta Campodoni, Monica Sandri, Doris Steinmüller-Nethl, Kristin Syverud, Kamal Mustafa, Izabela-Cristina Stancu

11:45-12:00 Production of Smart Wound Dressings Containing Gelma, Propolis and Green Tea Using 3D Printing to Support Diabetic Wound Healing. **Onur Ezgi Gezen**, Kübra Arancı Ciftci, Özgür Yılmaz, Azime Eraslan

12:00-12:15 Production of conductive scaffolds for tissue engineering applications; **Burcu Ozge Ozevin**, Büşra Oktay, Esma Ahlatcıoğlu Özerol

12:15-12:35 Nanoscale Cellulose Derivatives. **Serguei V. Savilov**

12:35-13:00 General Discussions

13:00-14:00 – Plenary SESSION III. MATERIALS FOR QUANTUM AND ENVIRONMENTAL APPLICATIONS – LINK

Chairs: Heiko FRANZ; Radu Claudiu FIERASCU

13:00-13:30 Integrating environmental phyto-remediation with biomass valorization for the recovery of some critical metals and energy by phytomining. **Maria GAVRILESCU**

13:30-14:00 Hot Quantum Materials. **Klaas-Jan TIELROOIJ**

14:00-14:30 – CLOSING CEREMONY – LINK

Chair: Ecaterina ANDRONESCU

PLENARY LECTURES

(Invited)

HARNESSING BIOGENIC NANOMATERIALS FOR SUSTAINABLE SOLUTIONS: INNOVATIONS IN ENVIRONMENTAL MANAGEMENT, HEALTHCARE, INDUSTRY, AND AGRICULTURE

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ABSTRACT

The global population has been forecasted to increase drastically to 9 billion in the year 2050, therefore, there is a clarion call to all scientists and relevant stakeholders to come up with innovative solutions that could help in meeting the unlimited need of the ever increasing population as well as help in achieving sustainable goals. Interestingly, the rapid advancement of nanotechnology has introduced a transformative paradigm in sustainable development, with biogenic nanomaterials at the forefront of this evolution. Majority of these are derived from natural sources such as plants, fungi, and microorganisms while these materials offer a myriad of applications that could address critical challenges in environmental management, healthcare, industry, and agriculture. Therefore, this invited talk intends to provide recent development from the application of biogenic nanomaterial in resolving different challenges from Environment, Agriculture, Health sector and in the Industry. Biogenic nanomaterials play pivotal role in restoration of heavily polluted environmental through their exceptional capabilities in air and soil bioremediation. Their inherent high surface area and reactivity enable efficient degradation of pollutants, including toxic heavy metals and organic contaminants. This innovative approach not only facilitates the cleanup of polluted environments but also aligns with the principles of the circular economy by promoting sustainable waste management and resource recovery. The application of biogenic nanomaterials in environmental remediation underscores their role in advancing ecological sustainability. In healthcare, biogenic nanomaterials are revolutionizing therapeutic interventions with their applications in controlled drug delivery and regenerative medicine. The ability of these nanomaterials to be engineered for precise targeting enhances the efficacy of treatments while minimizing adverse effects. Their use in developing biocompatible scaffolds and implants for bone and tissue regeneration represents a significant advancement in regenerative medicine. The industrial sector benefits from the incorporation of biogenic nanomaterials in the development of novel materials and advanced processing techniques. Moreover, emphasis on sustainable industrial practices highlights the potential of biogenic nanomaterials to produce eco-friendly and high-quality products. In agriculture, biogenic nanomaterials offer innovative solutions for enhancing soil health, precision agriculture, and the controlled release of agrochemicals. Their application improves soil nutrient availability, supports targeted delivery of fertilizers and pesticides, and contributes to increased crop yields with reduced environmental impact. Therefore, the sector advances towards achieving food security and promoting sustainable farming practices by integrating biogenic nanomaterials into agricultural practices. On the whole, this scientific talk will elaborate more on next generation nanomaterials that are biogenic in nature and the prominent role they play in diverse sectors which represents a pivotal advancement in sustainable solutions. This might be linked

to their unique properties which enable them to perform numerous significant innovations that could address environmental, medical, industrial, and agricultural challenges, thereby, paving the way for a more sustainable and resilient future. This scientific talk will provide more information on translation research aspects of these biogenic materials and diverse transformative potential of these biogenic nanomaterials and the role they play in contributing to the advancement of sustainable development across multiple domains.

Keywords: Biogenic Nanomaterials, Environmental Management, Healthcare, Industry, and Agriculture.

PROCESSING AND DESIGN OF MATERIALS FOR BONE TISSUE ENGINEERING

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ABSTRACT

Considering the very high need of bone grafts, about 49% of the total market share of the grafting materials, many researchers focused their efforts in developing new and improved grafting materials: metals and alloys (firsts generation of biomaterials), ceramics and polymers (second generation of biomaterials), composites and nanocomposites (third generation of biomaterials) but also tissue engineered grafts (fourth generation of biomaterials). In the development of all these materials, researchers tried to design materials with improved or even new properties by compositional and morpho-structural design having in mind pure regenerative purposes or even the treatment of bone-specific diseases including infections, cancer, osteoporosis, etc. Since the very beginning, porous or dense materials were developed, in many cases biomimetic approaches were considered but also, starting from the second generation of biomaterials the circularity and green synthesis were more and more used in developing grafting materials. Currently, many researchers are trying to develop materials by exploiting the benefits of the additive manufacturing methods.

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INTEGRATING ENVIRONMENTAL PHYTO-REMEDIATION WITH BIOMASS VALORIZATION FOR THE RECOVERY OF SOME CRITICAL METALS AND ENERGY BY PHYTOMINING

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ABSTRACT

The study addresses the global shortage of raw materials and energy, driven by supply limitations, commodity scarcity, rising demand, and geopolitical and environmental instability. These issues have heightened the demand for critical raw materials (CRMs), particularly in the European Union, where reliance on external suppliers threatens economic and technological stability. The European Commission's initiatives, including the Raw Materials Initiative and the Strategic Implementation Plan (SIP), underscore the importance of securing CRM supplies to support green technologies and a circular economy. The 2023 EU criticality assessment highlights metals essential for industries like electronics, renewable energy, and transportation, and stresses the supply risks due to their concentration in a few countries.

The rapid depletion of CRMs essential for modern technology and sustainable energy systems has underscored the urgent need for alternative recovery methods that are both economically viable and environmentally sustainable. This research investigates phytomining, an innovative process combining phytoremediation and biomass valorization to extract valuable metals from low-grade ores or contaminated soils. Unlike traditional mining, which often requires extensive infrastructure and has significant environmental impacts, phytomining offers a low-impact, plant-based alternative that harnesses the natural metal-accumulating abilities of specific plants, known as hyperaccumulators, to absorb and concentrate metals in their tissues.

Phytoremediation is the initial stage in the phytomining process, where hyperaccumulating plants are cultivated on contaminated or metal-rich soils. These plants, capable of absorbing and storing high concentrations of metals like nickel, cobalt, copper, and zinc, offer a dual benefit: they extract valuable metals while remediating polluted soils. By mitigating heavy metal pollution, phytoremediation addresses the persistent threat posed by non-degradable contaminants in soils, which, if left unmanaged, can lead to long-term ecological and health risks. The use of hyperaccumulators is particularly advantageous in regions where soil contamination has rendered land unusable for agriculture or conventional development.

In the second stage, biomass valorization, the harvested plant material undergoes processing to extract the accumulated metals. Methods such as ashing, smelting, and leaching are applied to convert the biomass into a form of "bio-ore" rich in target metals. This bio-ore can then be refined using hydrometallurgical and

pyrometallurgical processes, including bioleaching and electrowinning, to recover purified metals suitable for industrial use. The PHYTOMIN project exemplifies this approach, with experiments focusing on the cultivation of plants such as alfalfa, rapeseed, white mustard, and pigweed on metal-contaminated soils. The study found that these plants effectively absorb and concentrate heavy metals, making them viable candidates for phytomining applications.

Experimental results from the PHYTOMIN project revealed the presence of metals accumulated in plant biomass, particularly in the roots. For example, pigweed demonstrated a strong ability to accumulate nickel and cobalt ions from moderately contaminated soils. Techniques such as chemical digestion and incineration were employed to maximize metal recovery, with incineration yielding higher metal extraction rates in certain cases. These findings underscore the potential of phytomining as a cost-effective and environmentally sustainable method for generating secondary raw materials, which could partially offset the demand for newly mined metals.

However, the large-scale implementation of phytomining faces several challenges. The success of phytomining depends on factors such as the bioavailability of metals in soil, climate and hydrological conditions, seasonal variability, and the physiological limitations of the selected plants. Additionally, phytomining may not be suitable for all metals, as its effectiveness varies based on the type and concentration of contaminants. Despite these challenges, phytomining potential for commercial application is promising, particularly as global demand for CRMs continues to rise. As technology advances, further research into plant biology, soil science, and extraction methods may help optimize phytomining processes, making it a more efficient and widely applicable solution.

In conclusion, phytomining represents a forward-looking approach that aligns with the principles of a circular economy, addressing both resource scarcity and environmental pollution. By converting contaminated land into a source of valuable metals, phytomining not only supports environmental cleanup but also contributes to resource security. This research advocates for the continued exploration and development of phytomining as a viable alternative for metal recovery, supporting the European Union goals for a resilient, sustainable, and resource-efficient economy.

2D TRANSITION METAL CARBIDES AND NITRIDES (MXENES) AND THEIR BIOMEDICAL APPLICATIONS

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ABSTRACT

More than 40 stoichiometric MXene compositions and dozens of solid solutions and structures with various terminations have been reported since the first report on $Ti_3C_2T_x$ in 2011 [1]. The number of possible MXene compositions is infinite if one considers solid solutions (more than 50 have been made in our lab) and combinations of surface terminations. New subfamilies of in- and out-of-plane ordered MXenes, oxycarbides, 2D borides, and silicides further expand the family of non-oxide 2D materials based on transition metals. MXenes have also opened an era of computationally driven atomistic design of 2D materials. Many MXenes studied to date are biocompatible, particularly Ti, Nb, Ta carbides, etc. They possess electronic, optical, mechanical, and electrochemical properties that differentiate them from other materials. In particular, Ti_3C_2 has high metallic and ionic conductivity, and its conductivity greatly exceeds that of carbon nanomaterials. Moreover, MXene properties are tunable by design and can be modulated using light or applied potential.

This presentation will discuss the structure, synthesis methods, biocompatibility, and biomedical application of several MXene variants. I'll explain the synthesis effect on composition and properties and outline prospects for biomedical applications of MXenes ranging from photothermal therapy to tissue engineering, biosensing, and implantable and epidermal electrodes [2-4]. This analysis is expected to pave the way for more MXene compositions to be explored in the biomedical and healthcare fields.

References

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INTRINSICALLY DISORDERED PEPTIDES ENHANCE REGENERATIVE CAPACITIES OF BONE COMPOSITE XENOGRAFTS

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ABSTRACT

Biomaterial scientists design organic bone substitutes based on the biochemical properties of the mimicked tissue to achieve near-native functionality. Several non-collagenous proteins in bone are known as intrinsically disordered proteins (IDPs), as they lack detectible ordered domains and a fixed 3D structure under physiological conditions. Many IDPs perform regulatory roles in a range of cellular functions, which motivated us to design two proline-rich disordered peptides (P2 and P6) and augment them into the SmartBone® (SBN) biohybrid substitute. Recently we reported an improved proliferation and osteogenesis of human osteoblasts and mesenchymal stem cells in the composite groups containing peptides (named here as SBN+P2 and SBN+P6) in vitro. To address the effects of these composites on bone formation and biomineralization, this in vivo study investigated their functions in critical-size craniotomy defects in 16 domestic pigs after 8 and 16 weeks of healing. For this purpose, we used cone beam computed tomography (CBCT), microCT (µCT), histology, immunohistochemistry, fluorescent labelling of abundant reactive entities (FLARE), synchrotron SAXS/XRD, optical photothermal IR (O-PTIR) microscopy and nanoscale atomic force microscopy-infrared (AFM-IR) analyses. Our results represent new synthetic IDPs as potential candidates for directing bone formation and biomineralization. In addition, the SBN+P6 stimulated significantly higher bone formation and biomineralization after 8 weeks of healing than other groups indicating its potential to stimulate early biomineralization. Finally, after 16 weeks of healing, the SBN+P2 induced significantly higher bone formation and biomineralization compared to other groups indicating its effects on later bone formation and biomineralization processes. In addition, the strong stretching of amide primary and secondary IR absorbance peaks at 1660 and 1546 cm^{-1} in the SBN+P2 group verified that this peptide experienced more conformational changes after 16 weeks of implantation with a higher phosphate intensity at 1037 cm^{-1} compared to peptide 6. P2 and P6 are promising for bone augmentation strategies in critical clinical applications. Finally, we concluded that FLARE and O-PTIR are promising tools for evaluating and diagnosing bone tissue's biochemical structure and the bone-biomaterial interface.

Keywords: Intrinsically Disordered Proteins, Proline-rich motifs, Bone regeneration, Bone graft substitute, Biomineralization

HOT QUANTUM MATERIALS

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ABSTRACT

Quantum materials exhibit several exciting ultrafast physical phenomena that are moreover potentially technologically useful. This is particularly true for quantum materials with massless Dirac electrons, such as graphene and topological insulators. When light is absorbed in these materials, electron heating occurs through electron − electron interactions on a 10-100 fs timescale, followed by electron cooling, typically involving the emission of phonons on a picosecond timescale. We have exploited these ultrafast thermodynamics to generate harmonics in the terahertz (THz) regime [1], which is particularly efficient in "quantum metamaterials" consisting of a quantum material and a metallic grating [2]. Thanks to an efficient "Coulomb cooling" mechanism between surface and bulk electronic states in topological insulators [3], we have recently demonstrated that the ultrafast thermodynamics can give rise to third-order terahertz harmonic generation approaching the milliwatt regime [4]. Furthermore, quantum metamaterials enable fast and gate-tunable conversion from THz light to visible light [5]. These results establish quantum materials as an excellent material platform for nonlinear terahertz photonics, with possible applications in next-generation wireless communication systems, among others.

Whereas these ultrafast thermodynamics in graphene and topological insulators are relatively well understood, this is not the case for twisted bilayer graphene near the magic angle. Using time-resolved photocurrent measurements, we have studied these dynamics, finding that the electron cooling dynamics in twisted bilayer graphene near the magic angle is very distinct from the dynamics in monolayer or non-twisted bilayer graphene. Specifically, the cooling time in near-magic twisted bilayer graphene is a few picoseconds all the way from room temperature down to 10 K. We ascribe these observations to Umklapp-assisted electron-phonon cooling, facilitated by the moiré pattern in twisted bilayer graphene [6]. These results establish twist angle as control knob for steering the cooling dynamics and flow of electronic heat, and have possible implications for the development of ultrafast detectors operating at cryogenic temperatures, among others.

Besides interesting phenomena related to the thermodynamics of electrons in quantum materials, there are also important questions that require answers related to the transport and dynamics of phonons in quantum materials and 2D layered materials. This is particularly true for transition metal dichalcogenides, such as $MoSe_2$, which are projected to be used in future transistor technologies. We studied how phonon heat transport changes with thickness [7,8], and have recently observed interesting novel heat transport phenomena in these ultrathin semiconductors, by exploiting our novel experimental technique to study heat transport directly in space and time [9,10].

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NANOMATERIALS FOR THE REGULATION OF INFLAMMATION

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ABSTRACT

Modulation of the innate and adaptive immune response is a key therapeutic approach for targeting most severe diseases, such as malignant diseases, autoimmune diseases, and infections. The existence of numerous mechanisms regulating the immune response often complicates the precise control of the host response, which may lead to developing side effects. Key immune cells at the crossroads of innate and adaptive immunity are dendritic cells (DCs), which tightly control inflammation and immune tolerance. The application of autologous immune cells educated in vitro, such as DCs, although promising, can be extremely expensive, and its effectiveness is often variable due to the complex protocols and variable conditions for cell therapy production. Nanomaterials could overcome numerous problems in immunotherapy. They possess a large surface area available for conjugation, allowing the binding and delivery of various combinations of biomolecules and antigens to the target tissues and cells. The production of nanomaterials is becoming increasingly cheaper, and the knowledge we gained is growing exponentially, both in terms of their physicochemical properties and their biocompatibility. Numerous studies, including our own on gold nanoparticles, carbon nanotubes, graphene quantum dots, cellulose nanofibers, nanocrystals, polymers, etc., have shown that nanomaterials can display intrinsic immunomodulatory properties, which depend on their source, shape, size, degradability, etc. Moreover, nanomaterials can trigger different signaling mechanisms, thus inducing different effects in DCs and the subsequent immune response. Combining the nanomaterials and their properties opens up numerous possibilities in immunotherapy, including the possibility for “precise education” of DCs in vivo, both in a temporally and spatially controlled manner. However, for the clinical application of nanomaterials, it is first necessary to resolve their safety and the mechanisms of interaction with the immune system. Here we argue that DCs present an excellent model for these kind of studies, enabling the rational designing of the nanomaterials suitable for novel immunotherapeutic approaches.

Keywords: Nanomaterials, Dendritic cells, Immune response, Immunotherapy, Biocompatibility

ADDITIVE MANUFACTURING OF BIO-AEROGELS WITH STRUCTURE-CORRELATED THERMAL, MECHANICAL, AND BIOLOGICAL PROPERTIES

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ABSTRACT

Biopolymer aerogels are lightweight, highly porous materials derived from natural polymers such as cellulose, chitosan, starch, and alginate, and are gaining increasing attention due to their sustainability and biodegradability, offering a more eco-friendly alternative to synthetic counterparts. These aerogels combine low density, large surface area, and tunable porosity, providing excellent mechanical strength, thermal insulation, and adsorption properties, making them suitable for diverse applications such as drug delivery, water purification, energy storage, and thermal insulation. Additive manufacturing (AM) has emerged as a versatile tool for creating complex geometries and customized functionalities in material design. However, the challenge with applying AM to biopolymer aerogels lies in selecting a method that preserves the desired microstructures while achieving intricate macroscopic designs in a single sample. The research team at Empa is working on a direct ink writing method for 3D printing intricate, high-fidelity biopolymer aerogel forms. These printed aerogels exhibit tunable anisotropic mechanical and thermal properties by incorporating fibers of different length scales into the hydrogel inks. The alignment of these structures significantly enhances mechanical strength and thermal resistance. Due to the special gel structures induced by the ink, the printed aerogels also demonstrate excellent rehydration properties for biomedical applications, retaining their high surface area (≈ 300 m^2/g) while significantly improving mechanical properties. Preliminary studies show that these printed aerogels exhibit excellent cellular viability (> 90% for NIH/3T3 fibroblasts) and significantly improved drug release profiles, such as for Ketoprofen.

Keywords: Biopolymers, Aerogels, Additive manufacturing, structure-properties correlation.

KEYNOTE LECTURES

(Invited)

SYNTHETIC AND BIONANOCOMPOSITE COATING FOR FRUITS AND VEGETABLES

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ABSTRACT

Coating of fruits and vegetables is common post harvest practice to whole fruits to reduce water loss, improve appearance by imparting sheen to the fruits' surface for aesthetic purposes, provide a carrier for fungicides or growth regulators and create a barrier to gas exchange between the commodity and external atmosphere. Waxing process reduces air permeability of the peel, avoiding the rapid oxidation of fruits and vegetables so that shelf life has been extended, especially when transport for long distances.

Morpholine, $O(CH_2CH_2)_2NH$ is a common synthetic solvent and emulsifier used in the preparation of wax coatings for fruits and vegetables [1]. Morpholine itself neither a taratogen nor mutagen but when undergoes dietary or environmental nitrosation, it will forms a N-Nitrosomorpholine which is known carcinogen [2]. Such limitation can be addressed by preparing bionanocomposite films and edible coatings for extending the shelf life of fresh fruits and vegetables. The use of Nano particles (NP) into bio/polymers provides numerous benefits over synthetic emulsifier. Chitosan, Poly vinyl alcohol (PLA), Carboxymethyl cellulose (CMC)-Guar gum, Sodium alginate-gum, Soy protein isolate (SPI) are some of the biopolymer which has been incorporated with common ZnO, Ag and TiO_2 NP which predominantly delayed the ripening process and surface microbial contamination which in large increased the shelf life of peach fruits [3].

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THE MYTH OF CARBON UPTAKE FROM ENVIRONMENT ON TI AND ANODIC TiO_2 SURFACES

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ABSTRACT

For biomedical applications, titanium and titanium based alloys are still one of the most used implant materials. In addition, for many applications, advanced surface modification techniques are further used to nanostructure or functionalize the surface of the implant materials to increase its bioactivity. The formation of titanium dioxide (TiO_2) nanostructures (nanopores, mesopores, nanotubes, etc.) on titanium through electrochemical anodization is a commonly employed technique for creating nanostructured surfaces. This process has enhanced biocompatibility and demonstrates a notable influence of nanotopography [1-4].

It is well known that Ti or TiO_2 is hydrophilic, with contact angles lower than 90° and more so for TiO_2, which typically can have a superhydrophilic behavior. And yet, in literature, there are reports on TiO_2 nanostructures, without any additional functionalization, having a hydrophobic behavior (contact angles > 90°), and such a hydrophobic behavior is linked with improved interactions for antibacterial or biomedical applications.

Here, we show that while anodic TiO_2 is hydrophilic and, in time, can uptake carbon from the environment (confirmed by XPS and also peak fitting of the C1s peaks), this correlates with an increase in the observed contact angle, which switches to a hydrophobic value (as shown in Figure 1). However, by simply cleaning the sample via immersion in ethanol, the TiO2 sample becomes hydrophilic again and the amount of C observed in XPS is reduced.

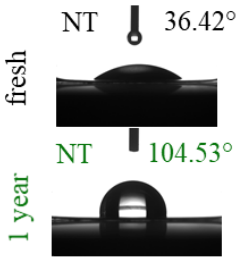

Figure 1. Contact angle images and values of fresh anodic TiO_2 nanotubes after 1 year storage. [4]

The data shows the dynamic nature of TiO_2 surfaces, specifically their reversible switch between hydrophilic and hydrophobic states through environmental carbon uptake. This point is crucial for biomedical applications, as surface hydrophobicity can influence antibacterial efficacy and biocompatibility, but in this case, after sterilization of the samples, the carbon uptake will be removed, and the hydrophilicity of the samples will be restored. The findings address a topic widely discussed in diverse biomedical contexts.

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TRANSPARENT COATINGS WITH ANTICORROSIVE AND SELF-CLEANING PROPERTIES FOR PHOTOVOLTAIC SOLAR PANELS

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ABSTRACT

The efficiency of solar photovoltaic panels can increase when its are protected from the effect of acid rain and dust deposited on their surface. Air pollutants such as NO_x, NH_3 and H_2S can mix with water in the atmosphere to form acid rain. Acid rain is a problem for buildings, windows as well as for solar panels that have a layer of glass on the side exposed to the sun. In this paper, research is focused on obtaining and characterization of non-crystalline coatings in the Ta_2O_5-ZnO binary system, deposited on a glass support similar to that used in solar cells, through e-gun technology. The aim of the research was to create an anticorrosive and hydrophobic surface with self-cleaning properties. This binary system was chosen because both oxides are semiconductors, as well as the anticorrosive properties in acidic media of Ta_2O_5 and the optical properties of ZnO. Electron beam technology is a deposition technique for producing dense and high purity coatings in a short time. The glass substrate of solar cells must be transparent, must have Eg greater than 3.2 eV and refractive index greater than 1.23. The same properties are required from protective coatings. In this work, non-crystalline (glassy) coatings with the desired characteristics were obtained. The coatings has a 75-80% transmission in the visible region. The morphology and roughness of the coatings were evaluated by atomic force microscopy. Roughness increases with the addition of zinc oxide. Roughness has a great influence on the hydrophobic properties of coatings. The contact angle measured for all coatings was over 91 degrees, showing the surface hydrophobic properties. It should be mentioned that the initial glass substrate was hydrophilic with a contact angle of 50 degrees. The X-ray diffraction (XRD) pattern showed the vitreous state of the coatings. The coatings deposited on the glass ensured anticorrosive properties in an acidic environment. The studied coatings presented the hydrophobic and anticorrosive properties that can provide a self-cleaning of the glass of the superlayer of solar photovoltaic (PV) panels; leading to their efficient operation.

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POSSIBILITIES OF ARTIFICIAL INTELLIGENCE

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ABSTRACT

Artificial Intelligence (A.I.) is rapidly transforming various sectors, bringing about groundbreaking innovations. From generating creative content to enhancing educational experiences, A.I. systems like ChatGPT, deepfakes, and generative tools for music, videos, voices, text are reshaping the way we interact with technology. This presentation explores the potential and versatility of A.I., focusing on key applications that highlight its capabilities. In this work, I will present the two sides of A.I.

Conclusions: While A.I. offers transformative opportunities, from advancing creativity to improving education, it is critical to address the ethical, economic, and societal implications. Balancing the benefits of A.I. with its risks is essential to ensure its responsible and equitable use.

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NANOSCALE CELLULOSE DERIVATIVES

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ABSTRACT

In light of current concerns about global climate change and dwindling natural resources, scientists have turned their attention back to natural polymers. The sharp example thru them – cellulose and its derivatives. This renewable chemical compound together with hemicellulose nd lignin are components of plants, serving the main source of cellulose for industry. Growing due to sunlight, water, and soil nutrients, they also plays a crucial role in removing of carbon dioxide from the Earth`s atmosphere. Cellulose is the most abundant polymer on the planet, contributing roughly 1.5×10^{12} tons to the Earth's annual biomass growth [1].

Structurally, cellulose is made of D-glucose units arranged in a rod-like conformation with domain sizes of nanometers range. Its filaments contains ordered and disordered regions allows it to be processed into various forms, from fibers and fibrils to micro- and nanocrystalline species. The yeild of these forms during synthesis depends on different factors: tye of the raw material, synthesis conditions, the processing method, which might involve acid hydrolysis, fermentation, and mass preparation by mechanical treatments. As a bonus, biomass processing also can yield other commercially valuable materials like lignin, biofuels, and conductive carbon.

Cellulose derivatives, like micro- and nanocrystalline samples, cellulose esters are versatile chemical species. First two can be tailored by surface modifications for combination with different polymer or carbon matrices, other can form hydrogels and aerogels. Recent researches demonstrate possibility of their combination with carbon nanostructures and bioactive substances, its self-organizing properties. Thanks to these innovations, cellulose-based materials are finding growing applications in industry ranging from construction and food production to biochemistry and flexible electronics. To fully unlock the potential of cellulose derivatives, researchers are using advanced instrumental techniques to study their structure and properties in details.

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CHLORINE DIOXIDE AS A VERSATILE PRESERVATIVE: MECHANISMS, GENERATION METHODS, AND POTENTIAL APPLICATIONS FOR FRUIT AND VEGETABLE PRESERVATION

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ABSTRACT

The growing demand for effective food preservation techniques has heightened the interest in chlorine dioxide ClO_2 due to its broad-spectrum antimicrobial properties. Fruits and vegetables are particularly vulnerable to spoilage due to microbial contamination and enzymatic activity. Chlorine dioxide has emerged as a potent oxidizing agent capable of disrupting microbial cell membranes, denaturing proteins, and inhibiting browning enzymes, thereby extending the shelf life of perishable produce. Exposure to both aqueous and gaseous ClO_2 effectively reduce bacterial loads, inhibit fungal growth, and maintain product quality across various commodities. This review highlights the mechanisms of action, the safety profile of ClO2, and the practical applications in food preservation, focusing on minimizing postharvest losses and enhancing food safety. The review underscores the potential of ClO_2 in addressing food security and sustainability concerns by reducing spoilage and preserving the sensory qualities of treated produce. The paper also discusses the challenges and future directions for the industrial adoption of ClO_2 as a preservative in active food systems.

DESIGN OF ELECTROSPUN N-DOPED CARBON DOTS/CELLULOSE ACETATE SYSTEM AS EFFICIENT ADSORBENT OF TOXIC DYES FROM CONTAMINATED WATERS

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ABSTRACT

Nowadays, only a fraction of water is suitable for consumption. The concerns related to water scarcity, aggravated by the growing population, required a pressing action (F et al., 2022). Water cleaning necessitates novel systems to efficiently remove several pollutants (Abdulhamid & Muzamil, 2023). For example, the use of composite membranes is gaining a great interest in the wastewater's applications. In this work, nitrogen-doped carbon quantum dots (N/CQDs), synthetized via an economic and eco-friendly methodology from agrowaste resources, were loaded into cellulose acetate fibrous systems as a novel and efficient multifunctional solution to remove toxic dyes, such methylene blue, from contaminated waters. Several batch adsorption tests were carried out by varying different process parameters (carbon dots loading, contact time, initial dye concentration, pH, temperature, salt concentration and adsorbent doses). The MB adsorption capacity rises with the increase in N/CQDs loading, ascribable to the higher availability of sites for adsorption. The maximum achievable adsorption capacity was 198 mg/g. Equilibrium experimental data were well described by Freundlich model. N/CQDs loaded fibrous systems were also tested for adsorbing other toxic dyes such as methyl violet and rhodamine B, demonstrating outstandingly high pollutant removal efficiency. Besides, the electrospun systems may be efficiently used in real scenario since their high recyclability (the removal efficiency slightly decreased after 5 cycles), paving the way to the production of innovative and efficient adsorbents for practical applications in wastewater purification.

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ORAL PRESANTATIONS

PRODUCTION AND CHARACTERIZATION OF WOUND DRESSINGS FOR BURN TREATMENT

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ABSTRACT

This study aims to eliminate the deficiencies of current methods used in the treatment of burn wounds and to provide a more effective solution. In this context, the potential of Aloe Vera, Chitosan and Propolis to accelerate the healing process of burn wounds was considered and synthetic biopolymer PVA was used to increase mechanical resistance. In the study, natural components were prepared in the light of the information obtained from previous studies, then these components were applied to the wound dressings by electrospraying method and finally the characterization of the coated wound dressings was determined. In this project, it is aimed to develop a biofunctional burn wound dressing by coating Aloe Vera (AV) and chitosan (Ch) wound dressings with propolis/PVA solution by electrospraying method. It was used to the obtained burn wound dressings some characterization methods such as SEM (Scanning Electron Microscopy) tests for imaging morphological properties, FTIR (Fourier Transform Infrared) for determining chemical structures, XRD (X-ray difractometer) for determining crystal structure and DSC (Differential Scanning Microscopy) for thermal properties will be employed. In addition, antimicrobial tests were performed. This research has been supported by Yildiz Technical University Scientific Research Projects Coordination Department with the Projects No: FYL-2024-6440.

NANONIZATION STRATAGEMS FOR IMPROVING INNOVATIVE EXTRACTION AND SIZE REDUCTION OF FASTIDIOUS BIOMATERIAL AND ITS PHYSICO-CHEMICAL CHARACTERIZATION

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ABSTRACT

Several plants have been shown their bioactive properties to provide antibiotic use. Plants based biomaterial can be used as a nontoxic phytomedicine too. Nearly 50,000 natural products in the form of medicines have been discovered from plants and among this, over 17,000 products derived from sea weeds. Plants also provides a numerous variety of biomaterials containing metabolites and natural bioactive medicinal compounds with anti-microbial, antiviral, antiprotozoal, antifungal, anticancer, antidiabetic, and other medicinal properties against various diseases. Many types nanonized plant based biomaterials have been investigated as potential medicines for several diseases. Bio-nanomaterials do behave differently to low-molecular-weight medicines and used to treat dangerous microbial diseases, cancer, tuberculosis and targeting drug delivery to damaged or disease affected organs. But all plant based biomaterials not to be easily extracted and they are not easily dissolved in water. This property of plant biomaterials leads to the difficult conditions such as macro sized coarse particles, poor dissolution rate. This is the reason that the plant and macro algae all are rich in fibrous or polysaccharides. They link the atoms and molecules get to gather in all the plane, due to agglomeration of particles takes place. Agglomerated biomaterials when dried and powdered they converted themselves as an amorphous materials. Amorphous materials do not have a fine particles and do not have good dissolution rate Because the crystallite size in amorphous material may be micro size. Thus, our work is designed to implement our conceptual novel techniques together with nanotechnologies for the reduction of particle size in a selective biomaterial and conversion of micro or macro sized biomaterial into an ultra-fine nano particles for potential usage counting as a medicine. For this study, we have utilized various standard techniques including, High energy ball milling, Ultra sonication, UV-VIS spectroscopy, XRD, SEM AFM, FTIR, GC-MS, Photon correlation spectroscopy (PCS), and Quasi-elastic light scattering (QELS), and Zeta potential analysis. Our research findings show The nanonized biomaterial yields the particles with larger surface area and allows greater interaction with the solvent, high extraction potential, and also increasing the solubility. To realized this goal, we have executed special modified novel techniques along with nanotechnology based instrumentation methods.

Keywords: Biomaterial**,** ball milling, nanonization, Solubility, Ultra sonication, Zeta potential.

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NUTRITIONAL PROFILE, FATTY ACID COMPOSITION, MINERAL CONSTITUENTS, AND ACUTE TOXICOLOGICAL ASSESSMENT OF THE FLESH OF H. ASPERSA MÜLLER

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ABSTRACT

The practice of snail flesh consumption by humans is not only widespread in various cultures around the world, but also deeply rooted in culinary traditions, highlighting an important aspect of human eating habits in different geographical regions. To rigorously evaluate the nutritional profile and potential toxicity associated with this delicacy, an in-depth analysis was conducted, focusing on the presence and concentration of key macronutrients, including proteins, total and reducing carbohydrates, various types of lipids, the complex composition of fatty acids, as well as essential mineral components that are crucial for human health. An acute toxicity study was carried out to determine the safety of the snail flesh H. aspersa Müller. The flesh of H. aspersa Müller has been found to possess a remarkably high concentration of essential nutrients, as well as a favorable n3/n6 fatty acid ratio and a significant predominance of unsaturated fatty acids, which collectively suggest a multitude of potential health benefits that could be derived from its consumption. In addition, this snail flesh is enriched with a wide range of essential minerals, including calcium, potassium, magnesium, phosphorus, sodium, cobalt, copper, iron, manganese and zinc, all of which play an essential role in various physiological processes within the human body. In particular, a portion of 100 grams of meat of H. aspersa Müller provides an approximate caloric value of 76.91 kcal, which represents about 3.84% of the recommended daily energy intake based on a standard diet of 2 000 kcal, highlighting its role as a low-calorie food option but rich in nutrients. The administration of an aqueous extract derived from the flesh of H. aspersa Müller did not lead to any mortality in the test subjects, thus indicating an LD50 greater than 2000 mg.kg-1 of body weight, a finding which underlines its safety for consumption. Given its remarkable concentration of essential nutrients, its favorable unsaturated fat content and its safety established through rigorous tests, the flesh of H. aspersa Müller is highly recommended for inclusion in the human diet, as it offers not only nutritional benefits, but also culinary versatility.

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FROM BIOMASS TO VALUE-ADDED MATERIALS: THE RELEVANCE OF BIOCHAR AND HYDROCHAR IN BIOREMEDIATION PROCESSES AND CIRCULAR ECONOMY FRAMEWORK

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ABSTRACT

Carbonaceous materials (e.g., biochar, hydrochar) are carbon-rich products derived from the thermochemical conversion of biomass. These materials have emerged as promising agents in bioremediation processes and contribute significantly to the circular economy. The relevance of these materials lies in their versatility: biochar, produced via pyrolysis, and hydrochar, derived through hydrothermal carbonization, both exhibit high surface areas, porosity, and abundant functional groups that facilitate contaminant adsorption and degradation. Studies have shown that biochar and hydrochar are effective at immobilizing heavy metals, pharmaceuticals, and organic pollutants in soil and water systems, thereby mitigating the adverse environmental impacts of these contaminants and enhancing ecosystem resilience (Smith et al., 2022). In bioremediation, these carbon materials act as adsorbents and catalysts. As well, they can be used as a support matrix for microbial communities involved in pollutant degradation, highlighting their multifunctionality (Li et al., 2023).

Within a circular economy framework, biochar and hydrochar valorize organic waste from various sources (e.g., crop residues, yard trimming, non-commercial wood and wood waste, manure, etc.) by transforming them into high-value products, thereby reducing waste, lowering greenhouse gas emissions, and promoting sustainable resource use. Their application extends to agricultural settings, where can improves soil fertility, enhances carbon sequestration, and reduces nutrient leaching, thus contributing to sustainable agricultural productivity (Jones & Tang, 2024). Furthermore, the scalability of biochar and hydrochar production aligns well with circular economy principles, offering viable, economically feasible pathways to recycle and reuse agricultural, forestry and urban waste. By incorporating these porous materials into bioremediation strategies, it is possible to advance environmental remediation efforts while encouraging sustainable technologies. The integration of these materials into diverse sectors exemplifies their potential to not only address pollution challenges but also create a robust circular bioeconomy, positioning biochar and hydrochar as key components in the transition to a more sustainable future.

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PRODUCTION AND CHARACTERIZATION OF APITHERAPY BASED WOUND DRESS

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ABSTRACT

Apitherapy is a type of treatment that occurs when bee products are used to protect human health or to treat people [1]. Apitherapy, which is said to have been practised in ancient civilisations, is still practised in countries such as Korea, the USA, China and Russia [2]. Bee products have an important place in traditional and complementary medicine due to their anti-inflammatory, antibacterial, antitumour, etc. properties [3]. Bee venom (BV) is a fluid secreted by bees for self-defence. BV, also called apitoxin, is one of the most important ingredients in cosmetics, pharmaceuticals and food supplements [4]. BV has been preferred in traditional medicine for the treatment of chronic inflammatory diseases due to its various properties such as anti-tumour, anti-arthritic, analgesic [5]. Propolis (Ps) contains beeswax, pollen, resin, phenolic acids and esters, flavonoids, sugars, amino acids, microelements. It is an agent which is used for wound healing either. Due to their anti-allergic and anti-inflammatory properties, BV and PS play an important role in wound management. Accordingly, biofunctional wound dressings containing BV and PS have high biocompatibility and antibacterial properties and help to complete the wound healing process in a shorter time. Polyvinyl Alcohol (PVA) is a synthetic polymer widely used in the use of wound dressings because it has properties such as biocompatibility, hypoallergenic, semi-permeability, flexibility, high mechanical strength, antimicrobial, hydrophilic and adhesiveness. Thanks to these general properties, it has advantages such as protecting the wound, not causing allergic reactions, reducing the risk of infection of the wound, not preventing the passage of oxygen and other gases, and being tolerated by the body [6]. This study will use 3D bioprinting, which is an innovative approach to the production of wound dressings with effective features such as customization, precise design and dosage adjustment according to need. The aim of this method is to produce polyvinyl alcohol (PVA)-based dressings containing BV and Ps, and to perform chemical and morphological characterization of the dressings after the production process. In addition to cytotoxicity, releasing and antibacterial tests to determine cell activities, the antibacterial effects of the dressings on E. coli and S. aureus species, which are microorganisms found in wound cultures, will be determined.

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DUAL-LAYER TISSUE SCAFFOLD WITH ANTIBACTERIAL PROPERTIES: MECHANICAL SUPPORT AND ENHANCED TISSUE REGENERATION FOR ADVANCED WOUND DRESSINGS

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ABSTRACT

Wound dressings are special features used to support wound protection and healing. Since the wound healing process consists of a complex series of biological events, the selection and use of the appropriate wound dressing is of great importance (Sibbald et al., 2019). Melt electrowriting (melt electrowriting) provides an ideal platform for tissue engineering and drug delivery applications by providing controlled fiber production at micro and nano sizes. The double-layered structure used as a wound dressing is designed for both mechanical support and temperature control system. A new double-layered tissue scaffold system with antibacterial cells is designed for wound dressing applications. PCL (polycaprolactone) is a biodegradable polymer and provides long-term mechanical stability of the dressing. The low degradation rate of PCL enables the controlled retention and disintegration of the wound dressing in the body, which allows it to act as a scaffold during the healing process. Morphological characterization of nanofibers produced by melt electrowriting method was performed by scanning electron microscopy (SEM). In addition, functional groups were examined by Fourier transform spectroscopy (FTIR) and the thermal properties of the scaffold were evaluated by differential scanning calorimetry (DSC). Antibacterial activity was confirmed by in vitro antimicrobial tests. The results show that this new double-layer scaffold produced by the PLA-encapsulated amoxicillin method has a promising potential for wound dressing applications. The study may inspire the emergence of advanced wound coatings that support temperature control and tissue regeneration. The electrospray method of amoxicillin and PLA on scaffolds stands out as a method that reduces the risk of wound healing processes and provides controlled drug release. The encapsulated structure of amoxicillin creates an effective barrier against heat-resistant parts, while at the same time maintaining the structural integrity of the wound dressing and supporting the healing process. This new approach has enabled the development of a wound dressing that provides both mechanical strength and climate control. This ability revealed that the developed double-layer scaffold showed high antibacterial activity in in vitro tests and is a promising candidate for tissue engineering applications. As a result, the use of amoxicillin encapsulated with PLA offers an advanced solution that can be a source of new research for wound dressing applications in the future. This developed structure has supported both climate control and tissue regeneration in the wound healing process. Such advanced methods can contribute to the development of new treatment methods that can be more effective in wound treatment and increase the living conditions of patients.

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DESIGN OF A PVA-BASED NANOFIBER WOUND DRESSING CONTAINING SILVER NANOPARTICLES REDUCED BY ALOE VERA TO ACCELERATE HEALING IN DIABETIC FOOT ULCERS

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ABSTRACT

One of the primary causes of diabetic foot ulcers includes the effects of vascular diseases, neuropathy, foot deformities, and traumas [1]. Diabetic foot ulcers, if left untreated, can lead to severe complications such as infection, tissue loss, and amputation, significantly impacting the patient's quality of life. Today, the treatment of diabetic foot ulcers is carried out using dressings and wound coverings. While traditional dressings and wound coverings may not always provide sufficient healing, the use of nanotechnological and bioactive materials offers significant advantages in wound treatment. In this context, biomaterials play critical roles in accelerating the healing process by promoting cell proliferation, maintaining moisture balance, and preventing infections [2,3]. In our study, we designed a nanofiber wound dressing based on polyvinyl alcohol (PVA) and containing silver nanoparticles reduced using aloe vera extract.

Silver nitrate is widely used in wound dressings due to its antimicrobial properties. However, silver nanoparticles obtained through chemical methods can cause problems such as toxicity and environmental harm. To prevent these problems, the green synthesis method using aloe vera extract was preferred. The green synthesis method allows for the production of nanoparticles in a biocompatible and environmentally friendly manner, eliminating the need for chemical reducing agents. In this way, the prepared wound dressing provides antimicrobial effects but also enhances biocompatibility [4,5].

The electrospinning method was used in the production of the proposed nanofiber wound dressing. Electrospinning enables the production of nanofibers with a high surface area and porous structure, promoting cell adhesion and supporting tissue healing. Additionally, the fibrous structures obtained by electrospinning provide a moist healing environment that protects the wound tissue [6].

Various characterization techniques were applied to evaluate the performance of the prepared nanofiber wound dressing. Scanning Electron Microscopy (SEM) was used to examine the surface morphology and homogeneity of the nanofibers. UV-Vis spectroscopy was employed to confirm the successful synthesis of silver nanoparticles. Antibacterial tests were conducted to determine the dressing's effectiveness against infections, and Fourier Transform Infrared Spectroscopy (FT-IR) analysis was used to investigate the chemical bonds of nanofibers. Additionally, tensile strength tests were performed to measure the mechanical durability of the nanofiber dressing [6].

The obtained data suggest that this green-synthesized, biocompatible, and antimicrobial nanofiber wound dressing offers an effective alternative for the treatment of diabetic foot ulcers. This study may provide significant contributions to wound treatment methods in the future by revealing the potential of nanotechnological biomaterials in wound healing.

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THREE-DIMENSIONAL GRAPHENE OBTAINED BY CVD SYNTHESIS

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ABSTRACT

Graphene, a two-dimensional structure of sp^2 carbon atoms arranged in a hexagonal pattern, exhibits a unique array of properties, including chemical stability, optical transparency, high mechanical strength, high carrier mobility, and a significant surface area. Various strategies have been explored to preserve the large surface area of graphene by assembling 2D graphene into 3D architectures [1-3]. Chen and collaborators introduced a novel approach for synthesizing template-assisted 3D graphene networks by etching the metallic template. 3D graphene networks produced were light and flexible, with low density (~ 5 $mg \cdot cm^{-3}$), high porosity (~ 99.7%), and high specific surface area (~ 850 $m^2 \cdot g^{-1}$ at about three layers) [4]. The unique properties of 3D graphene structures lend themselves to a variety of potential applications, including energy storage and conversion devices, environmental systems, bioelectronics, and oil sorption and filtration [5, 6]. It is anticipated that 3D graphene structures will demonstrate properties resulting from the synergistic blend of two-dimensional graphene characteristics and their unique architectural configuration.

Three-dimensional graphene networks (3D-GN) were synthesized by employing nickel or copper foam as substrates within a chemical vapour deposition (CVD) process utilizing methane as the carbon source. To obtain freestanding 3D-GN, we etched the Ni/Cu foam using hydrochloric acid. Following Ni/Cu etching, the freestanding 3D-GN was characterized using SEM, EDS, and XRD to assess the rate of Ni/Cu removal. Additionally, Raman spectroscopy was employed to evaluate the impact of the etching process on the freestanding 3D-GN structure.

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EMULSION SYSTEMS IMPACT ON BISTABILITY OF FERROELECTRIC LIQUID CRYSTAL FOR DATA STORAGE APPLICATIONS

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ABSTRACT

Ferroelectric liquid crystal (FLC) materials has been used to prepare and analyzed silicon oil-based emulsions. The quantities of silicon oil in the FLC matrix ranged from 0-50wt%. The devices were developed using these different concentrations of emulsion, and their performance was assessed using electro-optical methods, optical microscopy, and dielectric spectroscopy to assess bistability effect [1-3]. According to experimental findings, doping FLCs with silicon oil lowers the necessary driving voltage in these emulsions and creates a long-lasting bistability effect. Charge transfer close to the emulsion surface is probably the cause of this enduring bistability effect. Furthermore, the applied electric field seems to promote ion trapping at the interface between silicon oil and FLC, reducing the depolarizing potential in the emulsion devices and improving their bistability effect. Thus, such systems may open new possibilities for advanced storage device applications.

Keywords: ferroelectric liquid crystal; silicon oil; emulsion; bistability effect; ion trapping.

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REMEDIATION OF ZINC-POLUTTED SITES USING MUSTARD CROP

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ABSTRACT

Zinc (Zn^{2+}) is a key plant nutrient, ranked 3rd as the dominant metal after iron and manganese. Zn^{2+} mediates a number of plant metabolic/biochemical/physiological reactions. Therefore, an adequate supply of Zn^{2+} to plants is crucial for good metabolic functioning. Zinc is generally present as Zn^{2+} inside plants [1, 2]. Seeds are a developmental stage that is very important in the life cycle of the plant.

The purpose of the work is simulation of the effect of a polluted wastewater containing zinc ions (Zn^{2+}) asupra germinarii plantelor de mustar (Sinapis alba) [3]. It is known from specialized literature that mustard is a plant that retains heavy metals, this plant being used to remediate soils polluted with heavy metals [3]. In the first part of the experiment, I did the germination test - in 6 Petri dishes I put hydrophilic cotton wool, I practically prepared the dishes for germination, I put synthetically obtained zinc solutions in five of the dishes, with a concentration of 10 mg/L, 20 mg/L, 40 mg/L, 60 mg/L, 100 mg/L and a sample with distilled water. In each pot I added 20 mustard seeds, covered with hydrophilic cotton wool. After 4 days I weighed for each sample the stem and root height for each of the 20 seeds, then I weighed the wet germinated seeds, left them to dry and after a week I weighed the dry germinated seeds again.

After doing the germination test, I continued with the planting of the seeds in the soil, the soil polluted with zinc solutions of different concentrations, prepared before sowing for three weeks by watering by spraying with the established synthetic solutions. The obtained results are represented graphically in figures 1, 2:

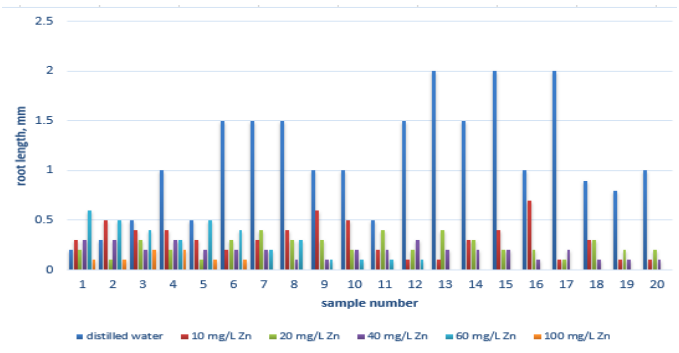

Figure. 1.Root length of seeds germinated in zinc solutions of different concentrations Zn^{2+} (10, 20, 40, 60, 100 mg/L).

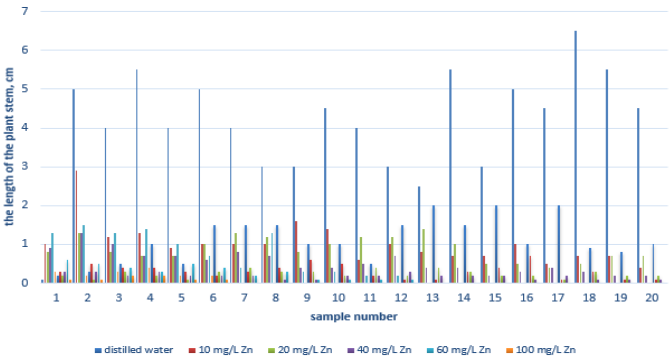

Figure. 2. Stem length of mustard plants grown in soil polluted with zinc solutions of different concentrations Zn^{2+} (10, 20, 40, 60, 100 mg/L).

The germination percentage calculated with the formula, G%) = Final number of seedling emerged/Total number of seeds sown * 100, is presented in table 1.

Table 1. Germination percentage depending on the concentration of zinc present in the water

Zinc concentration, mg/L	0	10	20	40	60	100
The degree of germination, %	100	100	100	100	60	30

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ADVANCEMENTS IN BIODEGRADABLE PACKAGING WITH NATURAL EXTRACTS: EMERGING PERSPECTIVES ON FOOD SAFETY APPLICATIONS

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ABSTRACT

The integration of natural extracts into biodegradable packaging materials represents a promising pathway for creating sustainable, functional food packaging that reduces dependency on synthetic materials while enhancing food safety [1,2]. Over the past decade, extensive research has focused on the development of biodegradable packaging solutions enriched with plant-derived compounds, such as essential oils, phenolic compounds, and flavonoids, known for their antimicrobial, antioxidant, and preservative properties. These compounds are sourced from a variety of natural extracts, including rosemary, thyme, oregano, and green tea, each demonstrating unique bioactive properties that can inhibit microbial growth, reduce lipid oxidation, and extend the shelf life of perishable foods [3].

The inclusion of natural extracts has been shown to significantly improve the physico-chemical properties of biopolymer-based films and coatings, particularly in terms of mechanical strength, water vapor permeability, and oxygen barrier functionality − critical factors for maintaining the quality and safety of packaged food [4]. Techniques such as encapsulation, emulsion formation, and nanoparticle integration have been explored to stabilize and control the release of these extracts, ensuring sustained bioactivity over time. Encapsulation methods, in particular, offer the added advantage of protecting the active compounds from degradation [5].

One challenge is optimizing the concentration of natural extracts to balance functional efficacy with material integrity for efficacy without compromising biodegradability. High concentrations of active compounds may affect the mechanical properties or reduce the biodegradability of the packaging [6]. Additionally, sensory impacts such as odor, taste, and color changes in packaged food products require careful consideration.

Despite these, challenges remain, including achieving uniform dispersion of extracts and assessing sensory impacts on packaged food. Evolving research is exploring new extraction methods, encapsulation techniques, and bio-based carriers to enhance the stability and release of active compounds. This study highlights current advancements and identifies gaps in achieving scalable, safe, and environmentally-friendly biodegradable packaging solutions that could better address food industry standards and more sustainable food packaging solutions.

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GOLD NANOPARTICLES SYNTHESIZED USING PLANT EXTRACTS FOR THE SPECIFIC DETECTION OF VARIOUS ANALYTES

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ABSTRACT

The emergence of new materials, combined with an increasing interest in nanotechnology, is propelling technological advancements across various domains, including clinical diagnostics, food analysis, and environmental monitoring. This trend has shifted the focus toward the biological synthesis of metallic nanoparticles, particularly gold nanoparticles (AuNPs), enabling us to utilize the unique functionalities provided by various plant extracts. Biologically synthesized AuNPs offer numerous advantages. The active compounds found in plants serve as both reducing and stabilizing agents, enhancing the functionality of the nanoparticles while also minimizing energy consumption and the reliance on harmful chemicals, thereby reducing production costs. These biologically synthesized AuNPs exhibit improved catalytic and antioxidant properties, making them suitable for the electrochemical detection of two significant molecules: hydrogen peroxide (H_2O_2), which is clinically relevant due to its role in generating oxidative stress, and perfluorooctane sulfonate (PFOS), an environmental contaminant known as a "forever chemical." The synthesized AuNPs were characterized using UV-Vis and FTIR spectroscopy, and their structures were visualized through transmission electron microscopy. Furthermore, electrochemical measurements were conducted to assess the analytical performance of the AuNPs, comparing these biologically synthesized nanoparticles with commercially available and chemically synthesized counterparts.

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ASSESSMENT OF THE EFFICACY OF HYALURONIC ACID AND MELATONIN ON *IN VITRO* BOVINE TOOTH REMINERALIZATION

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ABSTRACT

Tooth enamel, a complex biomaterial, is primarily composed of hydroxyapatite (HA), which is organized into mineral crystals. The unique physicochemical properties of enamel arise from its high mineral content and the parallel arrangement of apatite crystals within the enamel prisms. This biomaterial is susceptible to demineralization, a process that leads to the formation of early carious lesions. Demineralization occurs when organic acids penetrate the interprismatic spaces of the enamel, resulting in the dissolution of hydroxyapatite crystals and the release of calcium and phosphate ions, particularly when the ambient pH decreases.

This study aims to evaluate the efficacy of formulations combining hyaluronic acid (HA) and melatonin (MEL) with nanohydroxyapatite (nHAp) and grape seed extract (GSE) − both recognized for their remineralization properties − on the in vitro remineralization of bovine enamel subjected to artificial caries lesions. The assessment was conducted through surface microhardness analysis (MicroVickers) and Scanning Electron Microscopy (SEM). A total of five experimental groups were established: three treatment groups (G1: 10% (w/v) nHAp + 6.5% (w/v) GSE; G2: 10% (w/v) nHAp + 6.5% (w/v) GSE + 0.5% (w/v) HA; G3: 10% (w/v) nHAp + 6.5% (w/v) GSE + 0.2% (w/v) MEL), a positive control group (Colgate 1450 ppm fluoride toothpaste), and a negative control group, with ten bovine enamel samples allocated to each group.

The samples underwent microhardness analysis at three stages: prior to demineralization, post-demineralization, and after a 7-day remineralization cycle, during which the samples were treated with the experimental formulations. The effects of the treatments on remineralization were statistically analyzed using One-Way ANOVA followed by Tukey's post hoc multiple comparison test. The results indicated that the G3 group exhibited the highest remineralization effect, followed by G2, with the positive control group (G4) and G1 showing moderate effects. The negative control group (G5) displayed the least remineralization.

Additionally, SEM was employed to examine the surface morphology of the bovine enamel samples at all stages of the experiment, allowing for a detailed evaluation of the surface structures across the different treatment groups.

The findings of this study suggest that the formulations incorporating the established remineralizing agents nHAp and GSE, when combined with HA and MEL, significantly enhance the remineralization of artificial carious lesions in bovine enamel. Notably, the combination with MEL yielded the most pronounced remineralization effect, highlighting its potential utility in dental care formulations aimed at combating early carious lesions.

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PRODUCTION AND CHARACTERIZATION OF CAFFEIC ACID-LOADED WOUND DRESSINGS USING 3D PRINTING TECHNIQUES

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ABSTRACT

Medical healthcare has always struggled with effective wound healing. Since it requires developing innovative wound dressings to accelerate the healing process and minimizing the complications to get the best results from the healing process. Using 3D printing technology for the fabrication of wound dressing scaffolds is an often used way in this field. With this study we are aiming to fabricate and characterize caffeic acid (CA) loaded PCL-PVP scaffolds to apply for wound healing. With this PCL, PCL-PVP, and PCL-PVP-CA loaded scaffolds were fabricated using three different concentrations (20mg, 30mg and 40mg) of CA to PCL-PVP. Fourier transform infrared spectroscopy (FTIR) and Scanning electron microscopy (SEM) used to observe the chemical and morphological analysis of the 3D printed scaffolds. Thermal, mechanical and swelling properties are also examined. The drug release and biocompatibility results show that PCL-PVP-CA scaffolds have good potential to be used in tissue engineering.

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ULTRASOUND ASSISTED SYNTHESIS AND CHARACTERIZATION OF HYDROXYAPATITE/B-CYCLODEXTRIN COMPOSITE AS ADDITIVE FOR TANNING INDUSTRY

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ABSTRACT

The use of technologies and materials that result in environmentally sustainable products is one of the most important challenges facing the leather industry in the 21th century [1-2]. In fact, tanning products, additives and auxiliaries have a long-term environmental impact due to their difficulty and high cost of removal from wastewater, sludge, and solid waste. Thus, the development of additives obtained using a green technology and not affecting human health and the environment are desirable. Hydroxyapatite (HAp) is an excellent candidate for the synthesis of such additives due to its high biocompatibility, antimicrobial activity and fire resistance [3]. In addition, cyclodextrins (CDs) have been proved excellent as auxiliary for the tanning process as they can impart to leather properties such as fullness, colour persistence and breathability to leather. Moreover, CDs can increase HAp solubility helping this latter to spread better into the hide lattice [4]. Ultrasounds (US), an eco-friendly technology, and pure water with no addition of other solvents, were used to synthetize composites based on HAp and β-CD leading to the development of a product made in a sustainable way and without hazardous substances. The influence of different process parameters like US amplitude, treatment time and HAp/β-CD ratio were investigated. The final size and stability of the HAp/β-CD composites were studied by using dynamic light scattering and Z potential, while the interaction occurring between HAp and β-CD was investigated by Attenuated Total Reflectance Fourier-Transform Infrared (ATR-FTIR) and thermal gravimetric analysis (TG/DTG). The final shape of the composites was examined by scanning electron microscopy (SEM). All composites were tested against *Escherichia Coli*, *Staphylococcus Aureus*, *Staphylococcus Epidermis* and *Brevibacterium Lines*, and their cytotoxicity was investigated, too. They were eventually proven effective on a pilot scale in the tanning process.

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SILVER NANOPARTICLES MEDIATED BY *DAUCUS CAROTA* L. EXTRACT VIA FACILE GREEN SYNTHESIS AGAINST BRAIN CELL LINES

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ABSTRACT

Green synthesis of nanoparticles (NPs) has been a recent development in the field of nanotechnology. This kind of synthesis is a more eco-friendly approach compared to the chemical and physical methods. It involves the use of natural ingredients in the bio-reduction of metallic ions to nanoparticles [1,2]. This simple green eco-friendly method has been utilized to obtain metal nanoparticles using the leaf extract as a precursor [2-4]. Safer and easily metabolized drugs are natural compounds retrieved from plant materials as compared to other synthetic medicinal compounds. Metallic nanoparticles are mostly synthesized from precious metals viz., Ag, Au, Pt, and Pb. From these metals, silver is the most preferred in the area of the biological system due to its wide range of activities over other metals [1-3].

Carrot (*Daucus carota* L.) are rich in dietary fibre, antioxidants, anthocyanins, carotenoids, vitamins A, B, and C, and minerals. Ethnomedically, the roots of *D. carota* L. have been reported to be useful in the treatment of digestive problems, tonsillitis or constipation, and intestinal parasites[4].

An economical, efficient and environmentally friendly method was used for the green synthesis of silver nanoparticles by *D carota* L. leaf extract (DCLE). The obtained nanoparticles were characterized using UV-Visible Spectroscopy, Fourier-transform infrared spectroscopy (FTIR), powder X-ray diffraction (PXRD), transmission electron microscopy (TEM). The PXRD analysis showed that the synthesized Ag nanoparticles were crystalline in nature. The synthesized AGNPs from DCLE exhibited face-centered cubic phase with average particle sizes of 18.26±6.86 nm and 16.81±7.72 nm for AgNP05 and AgNP01 respectively. The antimicrobial activities of the plant extract and Ag nanoparticles were investigated against drug-resistant bacterial isolates using the disk diffusion method, while *in vitro* cytotoxicity assay by MTS end-point and xCELLigence real-time assays. The scavenging ability of DPPH radicals by the as-synthesized was studied for their antioxidant potentials.

The antimicrobial results showed that the AGNP-DCLE possess higher antimicrobial activities as compared to DCLE against the isolates. The study revealed that the compounds are capable of scavenging DPPH radicals in a dose-dependent pattern (IC_{50} = 2.61 ± 0.58 µM for extract (DCLE), 2.79 ± 1.75 µM for AgNP05, 2.84 ± 0.96 µM for AgNP01). The *in vitro* MTS end-point and xCELLigence real-time toxicity assays revealed that the cytotoxicity of AGNP-DCLE against U87MG brain glioblastoma cells showed ED_{50} = 87.31 µg/ml and 109.48 µg/ml.

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OPTIMIZATION STUDIES OF rGO-FeO-MnO_2-PPy AS ELECTRODE MATERIALS FOR ASYMMETRIC SUPERCAPACITORS

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ABSTRACT

The response surface methodology (RSM) was utilized to enhance the performance of bimetal-doped rGO nanocomposite synthesized via hydrothermal process for supercapacitor applications. The RSM statistically determined the optimum parameters for the synthesis of the bimetal doped carbon nanocomposites. Polypyrrole (PPy) was used to enhance the electrochemical performance of the nanocomposites. The nanocomposites were characterized using the following techniques: transmission electron microscopy (TEM), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Brunauer-Emmett-Teller (BET) and Barret- Joyner-Halenda (BJH) methods and energy dispersive X-ray analysis (EDX). Results indicate that the as-prepared rGO-FeO-MnO_2-PPy solid-state ASSCs delivered a high specific capacitance of 559.18 F/g at 0.5 A/g over an ultra-wide potential window (1.6 V) with excellent energy/power density (198.82 $Whkg^{-1}$/8000 Wkg^{-1} at 0.5 A g^1), superior cycling stability (~ 89.90% retention after 10,000 cycles), and extraordinary rate capability was achieved which was notably higher than those previously reported ASSCs for supercapacitors applications It was projected that the nanostructured PPy-coated bimetal composite electrode designed with KCl/PVA polymer gel electrolyte could be beneficial for attaining extraordinary performance. Moreover, the rGO-FeO-MnO_2-PPy solid-state ASSCs could continuously work even after multiple cycles and suggest huge promise as power sources for flexible and lightweight electronics applications. This work flowers a simple facile route to configurable lightweight and high-power energy ASSCs. The electrochemical behaviour of rGO-FeO-MnO_2-PPy samples was characterized by both three and two electrode system (Agudosi et al., 2021; Padash et al., 2023; Saeidi et al., 2018; Silas et al., 2019).

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THE CAPABILITIES OF CERIUM OXIDE IN GENERAL AND DENTAL TREATMENT

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ABSTRACT

In the last years, increasing biological interest is emerging for nanotechnology that can improve both general and dental health through implementation in their respective treatments, by using nanomaterials. In particular, cerium oxide nanoparticles, considered one of the most interesting nanomaterials for their catalytic properties, show a promise for application in therapy. [1-4]

Several materials are used in dentistry, which can be modified by applying nanotechnology. Nanotechnology has various applications in dentistry to achieve reliable treatment outcomes. The most common nanometals used in dental materials are gold, silver, copper oxide, magnesium oxide, iron oxide, cerium oxide, aluminum oxide, titanium dioxide, and zinc oxide (ZnO). [2, 3-6]

Designing bone grafts and prosthetic implants for wide clinical use can be challenging due to the complexity of integrated physiological processes and the general pathologies found in pacients. The revolutionary advances of nanotechnology in the biomaterial field expedite and endorse the current unresolved complexity in functional bone graft and implant design. Rare earth (RE) materials are emerging biomaterials in tissue engineering due to their unique biocompatibility, fluorescence upconversion, antimicrobial, antioxidants, and anti-inflammatory properties. [3-6]

Many disorders are associated with oxidative stress and inflammation, cerium oxide nanoparticles could prove a tool for the treatment of these pathologies. Cell cycle tests demonstrated that cerium oxide not only has good biocompatibility, but also promotes cell proliferation, resulting in optimal osteogenic ability. Proper bone regeneration is very important in the process of regenerating periodontal tissue and in guided bone regeneration techniques, in which new attempts come out along with the development of nanomaterials. [4, 7]

Recent advances in biomedical applications of micro or nano-scale RE materials have provided a foundation for developing novel, cost-effective bone tissue engineering strategies. An overview of RE

nanomaterials' technological innovations in bone tissue engineering and implantology summarized the osteogenic, angiogenic, immunomodulatory, antioxidant, in vivo bone tissue imaging, and antimicrobial properties of various RE nanomaterials, as well as the molecular mechanisms involved in these biological events [2, 4-8].

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THE EFFECT OF INFILL PERCENTAGE ON 3D PRINTED PVA SUBSTRATES: CONTROLLED GALLIC ACID RELEASE STUDY

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ABSTRACT

Three-dimensional printing (3DP) is an emerging technology in the pharmaceutical and food industries, offering new potential in personalized medicine/nutrition. 3DP builds objects layer by layer, enabling precise control over composition and dosage [1]. Fused deposition modeling (FDM) is widely used for its ability to shape thermoplastic materials like polyvinyl alcohol (PVA), valued for its thermoplasticity, solidification ease and water solubility [2]. However, how FDM parameters affect PVA-based tablet formability and function is still under investigation.

In this study, 3D printed objects were fabricated from PVA at different infill %; 22 (mininum infill), 44 (medium infill) and 100% (maximum infill) for the tablet model dimension of 10 × 10 × 2 mm (10-layered). The samples were then loaded with saturated gallic acid (GA) solution (80% (v/v) ethanol solution) by soaking method. After, GA loaded samples were immersed into Phosphate Buffered Saline(PBS) (pH 7.4), pH 1.2 and pH 6.8 at 37.5°C to mimic blood and gastrointestinal conditions, respectively. Sample aliquots were taken at determined time intervals during 24 h and released amount of GA was determined by UV Spectroscopy. The loading efficiency of the samples were found to be as 97.26, 115.45 and 46.53 mg GA/g gel for minimum, medium and maximum infill density,respectively. Maximum prolonged release was achieved at PBS while a sudden release was observed at pH 6.8. There was a significant difference in the release behaviour among the samples having different infill densities. The sample with maximum infill percentage was resulted in the lowest and retarded release under all conditions. Especially, at the end of 1 hour, release rates were obtained in the descending order as medium infill > minimum infill > maximum infill. The results showed that using infill percentage change in 3D printer is an alternative way to manipulate loading and release of GA in PVA based 3D objects.

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SUBSTITUENT EFFECT ON PYRAN-PYRAZOLE AS ORGANIC INHIBITORS IN AGGRESSIVE MEDIUM: EXPERIMENTAL AND THEORETICAL STUDIES

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ABSTRACT

Corrosion products are formed when a metal gives its electrons to the oxidizing substances [1], So we can stop this phenomenon by blocking this mechanism or incorporate some new product to make this reaction in our favor for the sake of environment concern and safety [2]. Therefore, pyrazoles as organic compounds are the best choice, which their efficiency is decided by the presence of aromatics and heteroatoms such as Nitrogen, Sulfur and oxygen atoms and multiple bonds in their molecules [3]. In addidtion to the Substituents that could change the whole molecule deportment.

The Aim of this work established on studying the substituent effect on the behavior of Pyran-Pyrazole derivetives as an organic corrosion inhibitors abstracting the corrosion process and shielding the metal surface from deterioration.Thereupon, we have applied experimentral and theoretical studies using mild steel in an aggressive medium HCl 1M, under static and dynamic conditions.Overall, the results spotlight the high efficiency of PP-Ph through all the concentrations, meanwhile the PP-PhNO_2 proclaims the same behaviour nevertheless its inhibition performances are not so great as PP-Ph in aggressive conditions at ambient temperature under concentration effect. The polarization curves, stand for a mixed-type inhibition behavior for both inhibitors. Beneath the temperature effect, the PP-Ph and PP-PhNO_2 show a more cathodic protection on keeping good performances comparing to the blank. Following the Langmuir adsorption isotherm, and coming from adsorption isotherms , The PP-Ph and PP-PhNO_2 are majorely interact via Physissorption besides the chemisorption process. The formation of protective layers of inhibitors on the MS surface was confirmed by the outcomes of MEB surface characterization. The composition of adsorbed layers on the MS surface was proved by EDX analysis. To figuring out the (-Ph) and (-PhNO_2) role during the inhibition process the DFT calculation and MC simulations were carried out.

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SUSTAINABLE CORROSION INHIBITION OF CARBON STEEL IN NACL SOLUTION USING CALCIUM-COBALT PHOSPHATE

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ABSTRACT

The corrosion of carbon steel in saline environments, particularly those containing sodium chloride, presents a significant challenge across various industries, including marine, construction, and transportation sectors. This research aims to address this issue by evaluating the efficacy of a novel calcium-cobalt phosphate inhibitor designed to protect carbon steel immersed in a 3% NaCl solution. Corrosion inhibition was studied using advanced electrochemical techniques, including potentiodynamic polarization and electrochemical impedance spectroscopy (EIS). These methods allowed for the measurement of corrosion rates and the determination of the inhibitor's protective performance in comparison to unprotected steel samples.

The study revealed that an optimal concentration of 50 ppm of the calcium-cobalt phosphate inhibitor led to a remarkable inhibition efficiency which exceeds 94%, significantly reducing corrosion rates. The impedance spectra also demonstrated a clear increase in the charge transfer resistance, confirming the formation of a protective layer on the steel surface. Further analysis indicated that the inhibitor not only enhanced corrosion protection but also contributed to improving the long-term durability of the steel by reducing the overall degradation rate. The results suggest that calcium-cobalt phosphate inhibitors are a promising alternative to traditional corrosion protection methods, offering a sustainable and environmentally friendly solution, especially in marine and other saline environments. This work provides valuable insights into the development of corrosion inhibitors that are both effective and environmentally compatible, advancing the knowledge in the field of materials protection and contributing to the prolongation of the service life of carbon steel structures while minimizing their environmental footprint.

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EVALUATION OF ANTIMICROBIAL AND ANTITUMOR ACTIVITIES OF FUNCTIONALIZED NANOSTRUCTURES

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ABSTRACT

This research explores the possibilities of using magnetite (Fe_3O_4) nanostructures combined with cerium oxide (CeO_2) in the field to combat drug-resistant bacterial infections and cancerous cells effectively. By combining magnetite cores with cerium oxide coatings, the study aims to enhance antitumor properties by increasing the production of reactive oxygen species (ROS) and carefully controlling structural characteristics. Advanced techniques such as scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) were used to validate spherical morphology and uniform elemental distribution.

The effectiveness of these structures in fighting bacteria and fungi like *Staphylococcus aureus* and *Escherichia coli* was tested. It demonstrated moderate efficacy but was hindered by its inability to spread well in liquids due to being hydrophobic. Tests on HeLa cell lines for cancer treatment showed promise by inducing apoptosis through ROS-mediated oxidative stress in the cancer cells, indicating potential for targeted cancer therapy.

These results support the idea that modified Fe_3O_4/CeO_2 nanostructures effectively manage infections and treat cancer but need further enhancement through surface alterations and improved bioavailability for better clinical outcomes.

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PRODUCTION OF SMART WOUND DRESSINGS CONTAINING GELMA, PROPOLIS AND GREEN TEA USING 3D PRINTING TO SUPPORT DIABETIC WOUND HEALING

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ABSTRACT

Chronic wounds associated with diabetes represent a significant global health challenge. These wounds, often slow to heal and prone to infections, are primarily caused by high blood sugar levels and compromised immune responses, which create an ideal environment for bacterial infections. Diabetic wounds can become chronic, leading to prolonged inflammation, increased healthcare costs, and decreased quality of life for patients. Current treatment options, including traditional dressings and bandages, mainly provide protection from external contamination but fall short in actively promoting tissue regeneration or preventing infection. Hence, there is a pressing need for more advanced, cost-effective, and efficient solutions to manage diabetic wounds. [1,2,3]

This project aims to address this need by developing a smart wound dressing made from GelMA (gelatin methacrylate), propolis, and green tea extract (Camellia sinensis). This innovative combination is designed to promote faster and more effective healing of diabetic wounds, while reducing the risk of infection and minimizing treatment time and cost. The use of natural and biocompatible materials in the wound dressing will provide not only structural support for tissue regeneration but also active biochemical support through antimicrobial and pro-healing properties. [4,5,6,7]

In summary, this project proposes the development of a smart wound dressing that integrates the natural healing properties of GelMA, propolis, and green tea to create an advanced treatment solution for diabetic wounds. The dressing's antimicrobial, pro-angiogenic, and tissue-supportive properties will address the key challenges of diabetic wound healing: infection risk, delayed tissue regeneration, and high treatment costs. By providing a faster, more efficient, and cost-effective solution, this innovative wound dressing has the potential to significantly improve the quality of life for diabetic patients while reducing healthcare burdens associated with chronic wound care. [4,5,6,7]

The proposed wound dressing was subjected to extensive characterization to ensure its suitability for biomedical applications. Techniques such as SEM (Scanning Electron Microscopy), FT-IR (Fourier Transform Infrared Spectroscopy), antibacterial tests were employed to analyze its structural, thermal, and mechanical properties. These analyses provided critical insights into the compatibility, stability, and functionality of the dressing materials. The results of this study are expected to guide future research on the use of natural and sustainable biomaterials in developing advanced solutions for chronic wound management, particularly in diabetic wound care.

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VASCULAR GRAFTS OBTAINED THROUGH THE 3D PRINTING TECHNIQUE

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ABSTRACT

Cardiovascular disease (CVD) is the principal cause of death globally which ascertains an increasing demand of designed vascular grafts, particularly among cardiovascular disease patients who require bypass surgery and lack autologous healthy blood vessels [1].Vascular grafts are used in numerous vascular surgeries around the world, although these procedures are constrained by vascular graft-related problems and size inconsistencies [2].Three-dimensional (3D) bioprinting provides a new technique for the direct development of vascular structures utilizing various natural or synthetic bioinks and cell types. An ideal bioink has good biological, rheological, and mechanical properties [3].

In consideration of the previous research's findings, the current study proposed the obtaining of 3D tubular matrices for blood vessel tissue engineering purposes based on some modified natural polymers (methacrylated gelatin – GelMA and methacrylated hyaluronic acid – HAMA) in combination with a synthetic polymer. According to the literature data, polymers such as gelatin (a polymer with biocompatible properties but reduced mechanical properties), sodium alginate (a polysaccharide that provides adequate viscosity to the (bio)inks, compensating for gelatin's mechanical properties), hyaluronic acid, (a polysaccharide with cell adhesion properties), are suitable for bioinks. Therefore, the study presents experimental results on the development and characterization of 3D printed tubular scaffolds based on biopolymers (methacrylate gelatin, sodium alginate, and methacrylate hyaluronic acid) and a synthetic polymer (polyethylene glycol) with wound healing properities of damaged blood vessels. The mixtures were homogenized, printed using an Inkredible Cellink bioprinter, freeze-drying for further analysis and subjected of characterization methods.

The scaffolds were assessed for their structure and morphology, degradability rate, mechanical characteristics and *in vitro* cytocompatibility. In the current study, the best results were obtained with hyaluronic acid and methacrylate gelatin inks, which presented good morphological properties, acceptable swelling degrees, good interaction with cellular medium, and efficiently preserved mechanical performance. The 3D printed matrices are non-cytotoxic and capable of supporting cell growth, making them appropriate for soft tissue engineering applications.

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ETHANOL PHOTO DEGRADATION ON NOBLE-METALS MODIFIED TiO_2 OBTAINED BY SOL-GEL METHOD

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ABSTRACT

The sol-gel process allows the synthesis of nanopowders with various compositions, purities, sizes, and dimensional distributions [1,2]. The photocatalysts in the form of powders were synthesized by the sol-gel route, and the metal precursors were added either during the synthesis (in one step) or by post-synthesis impregnation. Their use requires, first of all, their complex characterization. It is known that using a single method cannot give relevant information about the characteristics of these materials [3].

Characterization methods such as thermal analysis (DTA), infrared spectroscopy (IR), X-ray diffraction (XRD), X-ray fluorescence (XRF), and the determination of the specific BET surface area and pore distribution are complementary and necessary. As a result of the post-synthesis heat treatment, oxide compounds were obtained in the form of white (TiO_2), lilac (Au-modified TiO_2), and gray (Pt-modified TiO_2) crystallized powder.

The present research aims to investigate and evaluate the gas-phase oxidative photocatalytic degradation of ethanol under simulated solar light. TiO_2 was considered the most suitable photocatalyst for its high stability and high capacity to degrade different organic compounds. The photocatalytic activity of titanium dioxide synthesized by the sol-gel route was compared to that of gold and platinum doped photocatalysts, both during synthesis and by post-synthesis impregnation.

The improvement of catalyst performance for ethanol oxidative degradation can be achieved by: (i) introduction of electron trapping level in the band gap that can generate defects in the TiO_2 lattice and help capture charge carriers and by (ii) slowing down the recombination rate of the charge carrier and increasing the degradation of organic compounds [4].

In conclusion, the topic of the paper focuses on the development of the photocatalytic activity of simple and noble metal-modified TiO_2 used for the degradation of contaminants in the gas phase and ambient conditions.

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HYBRID HYDROGEL FOR WATER REMEDIATION APPLICATION

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ABSTRACT

This research describes an initial investigation into creating and optimizing hybrid hydrogels designed for wastewater remediation, using methylene blue dye as a model pollutant to assess effectiveness. The study focuses on synthesizing and characterizing a hybrid hydrogel formed from a poly (vinyl alcohol) (PVA) polymer matrix functionalized with Graphene Oxide(GO) and silver nanoparticles (AgNPs). The qualitative and quantitative effect was provided by methylene blue index. In conclusions, the synthetized hybrid hydrogels based on PVA decorated with silver nanoparticles exhibited excellent adsorption performance of methylene blue. [1,2]

Keywords: silver nanoparticles, hydrogel, graphene oxide, methylene blue adsorption, water remediation.

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DESIGN AND PRODUCTION OF 3D PRINTED TISSUE SCAFFOLD FOR USING IN SKIN TISSUE ENGINEERING APPLICATIONS

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ABSTRACT

Tissue scaffolds are structures that can support living cells, create a suitable microenvironment for them to grow and survive. It has porosity that allows the passage of nutrients and oxygen into the system. It allows cells to carry out many vital functions. It provides protection for embedded cells.[1]

Polyvinyl alcohol (PVA) is known for being biocompatible, biodegradable and non-toxic. It easily supports the formation of film structure. It has superior mechanical and water retention properties. [2,3]

Graphene oxide has superior mechanical properties with high specific surface area and tensile strength. Tissue scaffolds containing graphene oxide have porous structures and good water absorption ability, allowing the cell to grow while providing cellular adhesion to the target tissue in a harmonious way. It ensures that the tissue remains moist. The fact that it does not allow bacteria to grow on it leads to a safe and effective antibacterial effect. [4]

Silver nanoparticles has a fairly wide antimicrobial spectrum, including aerobic, anaerobic, gram-negative/ gram-positive bacteria, fungi and viruses. [5]

White mulberry leaf is known for its superior properties against behavioral and biochemical changes due to its richness in 1-deoxynogyrimycin, an α-glucosidase inhibitor that plays an important role in cell surface glycosylation and protein synthesis. [6] It is a good source of phenolics, thanks to this, they have many pharmacological activities in terms of antibacterial and anti-inflammatory effect.

In this study, was produced 3D tissue scaffold consisting of the components expressed as above for use in skin tissue engineering applications. The scaffold was characterized by various characterization techniques and the results are thought to potentially guide future research on the skin tissue engineering applications.

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NANOCOMPOSITE FILMS INCORPORATING AMLA EXTRACT, AGNP, CU-MOF FOR QUALITY ENHANCEMENT OF INDIAN CHEESE

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ABSTRACT

The study was carried out to fabricate and characterize the Alginate Carrageenan bionanocomposite films incorporated with Alma fruit extract, green-synthesized silver nanoparticles (AgNPs), encapsulated within the Cu MOF inclusion. The films were developed using film casting technique and evaluated for physicochemical, structural, mechanical, optical, and antimicrobial properties, enhancing the shelf life of cheese. The films were characterized for moisture content, thickness, color, opacity, water vapor permeability (WVP), and structural morphology. The film ACEM showed the lowest value (1268.3 gm-1day-1) for WVTR on the 9th day of the analysis imparting the structural integrity of the films. The structural smoothness in the film are revealed by the SEM analysis, confirming the uniform and through distribution of the extract and Cu MOF in the film structure. The addition of AgNPs significantly enhanced tensile strength, while Cu-MOF increased structural compactness.SEM and FTIR analyses confirmed uniform distribution and integration of Cu-MOF and AgNPs, resulting in a flexible, continuous, and compact film. The film sample ACNM exhibited the highest recorded DPPH antioxidant activity at 88.23%, followed by Ag-NP at 80.04% and CuMOF at 75.34%, while AC showed the DPPH antioxidant lowest activity at 6.43%. AE showed the highest inhibition (39.12 mm) for Bacillus subtilis, and against Escherichia coli, AE also showed 39.04 mm ZOI, with AgNP showing no inhibition. CuMOF achieved the highest inhibition (28.74 mm) against *Pseudomonas aeruginosa* while ACN had the lowest (13.21 mm). the application of films on cheese over 25 days, showed varying weight loss, with unwrapped cheese losing the most (18%) and ACE- and ACEM-wrapped samples showing the least.

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DESIGN AND FABRICATION OF A 3D-PRINTED MICRONEEDLE BILAYER PATCH FOR THE TREATMENT OF NON-MELANOMA CANCER

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ABSTRACT

Skin cancer is a significant disease in terms of global health, causing major psychosocial impacts and requiring substantial investments in treatments and technologies [1]. According to the World Health Organization (WHO), non-melanoma skin cancer (NMSC) is reported as a condition causing the death of more than 1,000,000 people annually, with one death occurring every four minutes globally [2]. Most NMSCs are treatable and non-fatal but can damage sensory organs like the nose, ears, and lips. Due to their spread, which requires larger excisions, they can cause substantial cosmetic issues and even result in the loss of motor functions [3].

Alongside traditional treatment approaches, the search for miracle cures continues, with microneedles recently gaining popularity in skin cancer treatment due to their high penetration rate through the stratum corneum, excellent biocompatibility, simple preparation process, high patient compliance, minimally invasive application, and lack of nerve-ending stimulation [4,5]. Most importantly, microneedles not only make it easy to deliver effective and rarely painful drugs but also allow for combination with multiple modality strategies such as photothermal therapy, immunotherapy, and gene therapy for synergistic effects [6].

In this study, Sodium alginate-gelatin methacrylate containing 5-fluorouracil was 3D printed via DLP (digital light processing) into microneedle form. For the first time in the literature, both Sodium alginate-gelatin methacrylate and gelatin methacrylate/5-fluorouracil solutions have been printed in a bilayer microneedle form using DLP. Additionally, Graphene Quantum Dot-loaded polyvinylpyrrolidone particles were synthesized and, for the first time in the literature, the Sodium alginate-gelatin methacrylate layer of the microneedle patch was coated using the electrospray method. As a result, a personalized bilayer microneedle patch product that can be used to treat the cancerous area in non-melanoma skin cancer has been developed.

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DEVELOPMENT OF CELLULOSE-BASED TEXTILE MATERIALS WITH IMPROVED SURFACE PROPERTIES

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ABSTRACT

This study investigates the development of bioleather derived from bacterial cellulose as a sustainable and cruelty-free alternative to traditional leather. By focusing on enhancing the surface properties of cellulose-based textiles, the research aims to replicate the mechanical, structural, and aesthetic characteristics of leather while offering an environmentally friendly solution. Using a multidisciplinary approach, the study integrates principles of bioengineering, material science, and surface chemistry to optimize the bioleather through bacterial cellulose synthesis, modification techniques, and surface treatments.

The research methodology includes experimental adjustments to processing parameters, the incorporation of sustainable additives, and innovative surface modifications. A comprehensive suite of characterization tests was conducted to assess the performance and durability of the bioleather. These tests include scanning electron microscopy (SEM) for surface morphology analysis, Fourier-transform infrared spectroscopy (FTIR) for chemical composition, tensile strength and elongation tests for mechanical properties, and water contact angle analysis for hydrophobicity and hydrophilicity. Flexing resistance tests were performed to evaluate the material's durability under repeated mechanical stress, while tear strength tests were conducted to assess its resistance to tearing, both in accordance with established international standards.

The results of the study show significant improvements in the mechanical and surface properties of the bioleather. The elasticity increased from 3% to 21%, and the modulus improved from 80 mPa to 163 mPa, indicating enhanced flexibility and strength. The water contact angle rose from 24° to 90°, demonstrating a substantial improvement in hydrophobicity. Flexing resistance also showed remarkable durability, with the bioleather enduring 62,000 cycles, far exceeding initial benchmarks. Tear strength was measured at 4.90 N/mm, confirming the material's increased resistance to tearing. These enhanced properties underscore the bioleather's potential as a superior, sustainable alternative to traditional leather.

This research addresses critical environmental challenges associated with conventional leather production – such as pollution, resource depletion, and ethical concerns – by utilizing the biodegradable and biocompatible nature of bacterial cellulose. The results demonstrate that the bioleather exhibits enhanced surface properties, strong mechanical performance, and superior durability, making it a viable alternative for industries seeking sustainable materials. Ultimately, this study contributes to the growing movement towards eco-conscious textile production, positioning bacterial cellulose-based bioleather as a promising innovation in sustainable design.

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ELECTRICAL CONDUCTIVITY, DENSITIES AND THERMAL EXPANSION COEFFICIENTS OF N-METHYL-N-(FERROCENYLMETHYL)PIPERIDINIUM BIS(TRIFLUOROMETHYLSULFONYL)IMIDE IN ACETONITRILE

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ABSTRACT

Nowadays demand for various types of electricity storage devices such as supercapacitors (SCs) and lithium-ion batteries grows rapidly. Along with the growth of demand, requests for the efficiency and safety of such devices are also increasing. Currently, ionic liquids (ILs) have been attracting interest as electrolytes due to the combination of unique properties including high electrical conductivity, electrochemical and thermal stability, low vapor pressure and wide electrochemical windows. At the same time the use of redox-active electrolyte is considered as the way to increase the electrochemical performance of SCs. Particularly, the reversible electron transfer Fe(III)/Fe(II) results to the increase in the specific capacitance and energy density of SCs based on ferrocene-containing electrolytes due to pseudocapacitive contribution. Despite the growing interest to feroccene-based ILs the available literature data is mainly related to their synthesis and electrochemical study.

In this work we present transport properties of a new ferrocene-based ionic liquid N-methyl-N-(ferrocenylmethyl)piperidinium bis(trifluoromethylsulfonyl)imide in acetonitrile. The electrical conductivity was measured using a SevenCompact™ S230 conductometer fitted with an InLab® 710 conductivity sensor in the temperature range of 298–348 K. The electrical conductivity – IL mole fraction dependences were analyzed using the four-parameter Casteel-Amis equation [1]. The highest electrical conductivities of the IL solutions in acetonitrile increased from 23.9 ± 0.3 (298 K) to 38.1 ± 0.6 mS/cm (348 K). The pronounced maximum observed on the experimental curves was attributed to the competition effect: in the range of low IL concentrations the increase in IL mole fraction resulted to the improvement in electrical conductivity due to the growth of the number of charge carries while the enhancement of ion-ion interactions led to increase in viscosity at higher IL concentrations obstructing charge transfer. The activation energies of conductivity were analyzed using the Arrenius and Vogel-Fulcher-Tamman (VFT) approaches [2]. In contrast to the Arrhenius equation, the VFT model was found to describe electrical conductivity – temperature dependences with high accuracy. The activation energies increased with the IL mole fraction because of the growing of viscosity. In addition, densities ρ of the IL solutions in acetonitrile were measured and isobaric thermal expansion coefficients were calculated. The dependences of $\rho(T)$ showed the linear trend and decreased with the increase in temperature.

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FUNCTIONALIZATION OF HIMACHALENE DERIVATIVES: SYNTHESIS OF NOVEL FUNCTIONALIZED SESQUITERPENES

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ABSTRACT

Terpenes are a highly sought-after compounds due to their biological activity and applications in multiple domains such as pharmaceuticals, cosmetics, perfumery, and synthetic chemistry. Therefore, synthesizing novel terpenes from existing natural feedstocks offers a promising approach to obtaining new highly added value compounds with unique properties.

In this context, functionalization of himachalenes, the major components of Moroccan atlas Cedar oil. Can lead to the obtention of new compounds with different properties. However, himachalenes reactivity present a challenge due to the poor selectivity of reactions that can be performed on these natural sesquiterpenes. In order to circumvent this difficulty, we have synthesized γ-dehydro-arylhimachalene, an aromatic olefin and minor component of the same oil, from himachalenes mixture (α-himachalene, β-himachalene, γ-himachalene). γ-Dehydro-arylhimachalene was obtained via an iodine/DMSO mediated aromatization of himachalenes with a good yield [1]. The exploration of catalytic functionnalization of the latter using palladium catalyzed allylic acetoxylation led to the formation of novel acetoxylated derivative of himachalene [2].

Moreover, Oxidation of γ-dehydro-arylhimachalene using ruthenium and vanadium catalyzed oxidation, led to the synthesis of novel oxygenated sesquiterpenes that can be explored for their biological as well as olfactory properties.

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COLLAGEN-BASED COMPOSITE BIOMATERIAL FOR MEDICAL APPLICATION

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ABSTRACT

Diseases associated with bone of different etiology such as bone tumors or voluminous defects caused by accidents represent a major concern in the medical field. The need to obtain bone grafts is reflected by the large number of requests. Bone grafting covers areas such as oral-maxillo-facial surgery, traumatology and orthopedics, implantology, thus the development of materials for grafting is an imperative in time. Collagen is a template for the generation of skeletal elements made by its in vitro mineralization process. This study lies at the interface between tissue engineering and chemical engineering and focuses on the development of composite biomaterials based on hydroxyapatite and collagen extracted from the umbilical-placental complex. *In vitro* mineralization was performed directly starting from collagen hydrolyzate and hydroxyapatite precursors. The obtained biomaterials were evaluated by SEM, FTIR and TG-DSC.

Figure. 1 Composite biomaterials based on collagen.

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GOLD AND ZINC OXIDE NANOCOMPOSITES FOR ENHANCED DETECTION BY RAMAN SPECTROSCOPY

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ABSTRACT

Surface-enhanced Raman scattering (SERS) is a very useful tool to identify chemical subtances exploting the inelastic scattering of light from molecules to yeld the optical fingerprint of chemicals and biomolecules [1]. The present study investigated the synthesis of ZnO nanorods decorated with gold nanoparticles (Au Nps) for enhanced detection of molecules by Raman spectroscopy. ZnO having a band gap of 3,3 eV, it is considered as a semiconductor that displays high optical transparency and luminescent properties in the near ultraviolet and visible regions. [2]. On the other hand, the nanochemistry of Au Nps reveals variety of advantages such as size and shape dependent chemical and physical properties [3].

ZnO/Au nanocomposites have been studied by different research groups using several methods of synthesis such as: chemical vapor deposition (CVD), electrodeposition, wet-chemical synthesis, hydrothermal method, etc. Therefore, nanocomposites of ZnO/Au attract a lot of attention due to their unique applications in photocatalysis, solar cells and biological detection [4]. The combination of these properties makes ZnO/Au nanocomposites a promising SERS substrate which possesses high enhancement, reproductibility and can be reusable [1].

We succesfully prepared ZnO/Au Nps nanocomposites combining two hydrothermal methods for the synthesis of ZnO nanorods with two chemical methods for the synthesis of Au Nps. The amount and size of Au Nps on ZnO nanorods is controllable by dipping time of ZnO nanorods in the Au Nps solution. The main approach is focused on hydrothermal synthesis of ZnO and microwave-assisted Turchevich method of synthesis of Au Nps, both used as raw material to produce ZnO/Au nanocomposites. Au NPs were chemically grafted at the surface of ZnO nanorods by a simple, easy and efficient technique. ZnO/Au nanocomposites have been supported on microscope glass slide as a substrate.

The samples were characterised by different methods: scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), transmission electron microscopy (TEM), X-ray diffraction (XRD), surface enhanced Raman scattering (SERS). The optical activity was studied by UV-Vis spectroscopy and photoluminescence (Pl).

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FE-CR-NB-B MAGNETIC NANOPARTICLES: A PROMISING TOOL FOR TARGETED CANCERCELL DESTRUCTION

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ABSTRACT

The use of magnetic micro- and nanoparticles (MNPs) in cancer therapy is a rapidly evolving field, offering innovative solutions for tumor treatment. Fe-Cr-Nb-B magnetic particles [1] have demonstrated exceptional potential due to their unique combination of magnetic, structural, and biocompatibility properties, enabling applications such as magnetic hyperthermia (MHA), magnetomechanical actuation (MMA), and chemotherapeutic drug delivery. Their adjustable Curie temperatures, ranging between 1552°C depending on composition, and shape anisotropy make them effective in mechanical cancer cell destruction and self-controlled thermal therapies.

In this study, Fe-Cr-Nb-B magnetic particles were synthesized by high-energy ball milling of amorphous ribbons, producing parallelepiped-shaped particles with dimensions of 10–200 nm. These particles demonstrated high saturation magnetization values of up to 81.15 emu/g and tailored Curie temperatures for specific therapeutic applications. $Fe_{67.2}Cr_{12.5}Nb_{0.3}B_{20}$ was optimized for hyperthermia treatments with a Curie temperature of 47°C, while $Fe_{68.2}Cr_{11.5}Nb_{0.3}B_{20}$, with a Curie temperature of 52°C, was ideal for MMA. The particles were dispersed in a ferrofluid and introduced into human osteosarcoma (MG-63) cell cultures to evaluate their therapeutic potential [2].

The biocompatibility of the MNPs was confirmed, with no significant cytotoxic effects observed at concentrations up to 2 mg/mL. In hyperthermia experiments, cell viability decreased to 32%, as the alternating magnetic field induced temperatures around 44°C, leading to thermal cell death. Similarly, MMA induced by rotating magnetic fields at low frequencies (2 Hz) decreased cell viability to 31%, demonstrating the mechanical disruption of cell membranes and intracellular components.

When loaded with chemotherapeutic drugs, including mitoxantrone and doxorubicin [3], the particles provided enhanced therapeutic effects. Drug encapsulation efficiencies reached 74.5% for mitoxantrone and 70.2% for doxorubicin, while the dual-action therapy, combining MMA with controlled drug release, achieved cell viability reductions to ~10%. Fluorescence microscopy confirmed intracellular localization of the drug-loaded MNPs, visualizing their presence in the cytoplasm, lysosomes, and on cell membranes.

The study highlights the multifunctionality of Fe-Cr-Nb-B particles in cancer treatment, effectively integrating hyperthermia, magnetomechanical effects, and targeted drug delivery. Their tunable properties enable precise control over therapeutic mechanisms, minimizing systemic toxicity while maximizing treatment efficiency. These findings underscore their potential as powerful tools for multimodal cancer therapies.

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IMPACT OF GALLIC ACID IN WASTEWATER ON WATER QUALITY AND HUMAN HEALTH: CHEMICAL MECHANISMS AND HEALTH RISKS

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ABSTRACT

Gallic acid (3,4,5-trihydroxybenzoic acid) is a phenolic compound present in various natural and industrial sources, including wastewater. It is present in various plants and products derived from them, such as fruits and vegetables, teas, beer, wine and various plant extracts. The highest concentration of gallic acid (GA) is found in vegetables (0.6-27.0 mg/g), in the infusion of white, green and black tea (0.7-4.98 mg/mL), in wines and its derivatives (0.6-4.0 mg/mL), in fruit (0.6-4.67 mg/g) and fruit juice (0.1-0.45 mg/mL), in beer (0.07-0.11 mg/mL) etc. Gallic acid, a naturally occurring polyphenolic compound, exhibits low bioavailability in humans, with approximately 70% excreted via urine. Consequently, it frequently enters natural waters through industrial and municipal wastewater, raising concerns about its environmental and health impacts. Because, locally, there are factories for the processing of grapes and their derivatives, for the production of beer, for the processing of vegetables and fruits, for the manufacture of some pharmaceutical and cosmetic products, the concentration of gallic acid in the environment is estimated to be higher than provides the EU legislation, where the maximum admissible concentration is between 0.001 and 1.0 mg/L [1]. This study investigates the variability of gallic acid concentrations in wastewater from different agro-industrial sources and evaluates its effects on water quality and human health. It also examines the chemical mechanisms through which gallic acid contributes to the formation of hazardous by-products during water chlorination [2].

The concentration of gallic acid in wastewater varies significantly depending on the industrial source, influencing its levels in natural waters. Excess gallic acid in aquatic environments alters water composition by increasing color and odor, and it can be toxic to aquatic organisms, leading to reduced oxygen levels, eutrophication, and loss of biodiversity. Chronic exposure to gallic acid through contaminated water can result in human health issues, including skin and mucosal irritation, and at higher concentrations, systemic toxicity. Additionally, during the chlorination of drinking water, gallic acid can react with chlorine to form carcinogenic by-products, including trichloroethanes and chlorinated acetic acids.

Regular monitoring and effective removal of gallic acid from wastewater are essential to prevent its adverse effects on water quality and human health. Understanding the chemical reactions involved in chlorination is crucial for minimizing the formation of harmful by-products and ensuring safe drinking water.

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THE POTENTIAL OF NANOTECHNOLOGY AND BIOMATERIAL IN ALZHEIMER DISEASE

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ABSTRACT

Alzheimers Disease (AD) is a progressive brain disorder that gradually damages memory, thinking, and behavior, impacting millions of people and their families worldwide. Despite wide research, effective treatments to slow or stop the disease are still lacking, making the search for new solutions more urgent than ever.However, emerging fields like nanotechnology and biomaterials engineering offer new hope for transforming Alzheimer's care.

Nanotechnology, which manipulates materials at the molecular level, is opening up exciting possibilities. For instance, nanoparticles can cross the blood-brain barrier, allowing for targeted drug delivery directly to the areas of the brain impacted by Alzheimer's. This could make treatments more effective and reduce side effects. Additionally, these nanoparticles may help detect Alzheimer's earlier by identifying biomarkers – like amyloid plaques and tau tangles – that signal the disease long before symptoms appear. Nanomaterials are also improving brain imaging, enabling earlier and more accurate diagnoses.

Biomaterials engineering is playing a crucial role as well, designing new drug delivery systems that can release treatments directly where they're needed and developing neuroprotective agents that may help repair or protect brain cells from damage. Together, these innovations could offer more targeted therapies. that aim to slow or even change the course of Alzheimer's, rather than just managing symptoms.

While safety concerns and regulatory hurdles remain, the progress being made in these fields is promising. With continued research, nanotechnology and biomaterials may one day offer a breakthrough that could change the lives of millions living with Alzheimer's, offering not just better treatment options, but hope for a future without the disease.

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ASSESSMENT OF COPPER CORROSION RESISTANCE IN 0.5M H2SO4: A COMPARATIVE INVESTIGATION USING EXTRACTS FROM TWO MOROCCAN PLANTS

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ABSTRACT

Copper corrosion is a significant issue in various industrial applications, particularly in acidic environments where metal degradation can lead to substantial economic and structural impacts [1]. Organic inhibitors derived from natural sources have garnered attention as environmentally friendly alternatives to synthetic inhibitors [2].

In this context, our study aims to evaluate the anticorrosive properties of two Moroccan plants against copper corrosion in a sulfuric acid medium. The rich composition of these plants in polyphenols and flavonoids was identified, with E1 containing specific compounds like ascorbic acid, gallic acid, vanillin, and quercetin, while E2 includes salicylic and benzoic acids. These compositions were tested for their effectiveness in inhibiting copper corrosion in 0.5 M H_2SO_4 using electrochemical methods. The extracts demonstrated a mixed inhibition effect, achieving promising efficiencies of 95.2% for E2 and 94% for E1. Thermodynamic parameters provided insight into the activation mechanisms, underscoring the potential of these extracts as effective corrosion inhibitors.

Keywords: HPLC, polyphenols, inhibitor, copper, extract.

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IMPROVEMENT OF NEW POTENTIAL BIOMATERIALS AND THEIR CHARACTERIZATION USING TECHNIQUES, SUCH AS MICROSCOPY, SPECTROSCOPY, ELECTROCHEMISTRY, CHROMATOGRAPHY ETC.

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ABSTRACT

The continuous advancement of biomaterials is essential to meet the evolving demands of medical and engineering applications, particularly in enhancing biocompatibility, durability, and antimicrobial properties [1]. This presentation explores innovative approaches to improving potential biomaterials, focusing on innovative approaches to material design and characterization techniques that reveal key properties critical to their practical application.

Based on recent studies, we explore a range of biomaterials – including electrospun polylactic acid and polycaprolactone (PCL) coatings loaded with antibiotics, as well as complex bioactive chitosan-bioglass coatings applied to high-entropy alloys [2]. These materials demonstrate advancements in antimicrobial resistance, stability, and biocompatibility, addressing some of the most pressing challenges in biomaterial engineering.

Through diverse characterization methods, including microscopy, spectroscopy, electrochemistry, and novel deposition techniques like electrodeposition from natural deep eutectic solvents, each study sheds light on the performance of these materials under conditions that simulate real-world applications. For example, vancomycin-loaded PCL wires and gentamicin-infused coatings exhibit strong antimicrobial properties, while advanced Ti-based alloy coatings offer enhanced structural resilience. The insights gained from these analyses highlight the value of using multifaceted characterization approaches to tailor materials for specific applications.

Ultimately, this presentation provides an integrative view of the promising directions in materials research, underscoring the importance of combining innovative material formulations with precise characterization techniques [3]. These advances not only improve the functional properties of biomaterials but also pave the way for safer, more effective applications.

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THE EFFECT OF CELLULOSE NANOFIBERS' CONCENTRATION ON THE BEHAVIOR OF NANOEMULSIONS

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ABSTRACT

From an environmental perspective, replacing various petrol-based compounds is still a challenge that needs to be addressed. When using such materials in an over-consuming sector, like the health industry, where reuse and recycling are not options, research on bio-based alternatives is mandatory. Cellulose, in its nano forms, is one material that has found multiple uses in biomedicine due to its adaptable character. Besides being renewable, it possesses other valuable traits like high surface area, the capacity to absorb exudates, biocompatibility, lack of toxicity [1], and, relevant to this paper, the capacity to deter the separation of an emulsion in its two phases (oil and water). The abundance of hydroxyl groups on the cellulosic surface opens further areas of application [2].

In this work, cellulose nanofibers, or oxidized cellulose nanofibers, were used, in several concentrations, as stabilizers for the formulation of nanoemulsions with antibacterial properties. Because either form of fiber lacks antibacterial activity, the systems were enhanced with curcumin (from *Curcuma longa*) a natural compound with effect against Gram-positive and Gram-negative bacteria. The influence of the type of cellulose nanofiber used, oxidized or unoxidized, and their concentration on the type, droplet size, and stability of the nanoemulsions in time was investigated by the dilution test, dynamic light scattering (DLS), and optical microscopy (OM). The antibacterial effect of the emulsions against various bacterial strains was tested using the disc diffusion method. The data gathered showed that both unoxidized and oxidized cellulose nanofibers are appropriate for use in emulsion systems.

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THE USE AREA OF BACTERIAL CELLULOSE COATED WITH SALVIA OFFICINALIS(SAGE) ESSENTIAL OIL IN WOUND DRESSING APPLICATIONS

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ABSTRACT

Bacterial cellulose (BC) is the purest form of cellulose, produced through oxidative fermentation. Compared to plant cellulose, it stands out as a biopolymer with various advantages, such as purity, high porosity, liquid and gas permeability, high water retention capacity, and mechanical strength [1,2,3]. It has also become preferable due to its simpler and more cost-effective purification process [2]. In addition to accelerating wound healing, retaining water and drugs, and providing excellent compatibility with the body, BC has a modifiable structure. In this context, the use of natural plant oils to promote wound healing is also covered in the literature.

The essential oil of the sage plant (*Salvia Officinalis*) can be used to enhance the healing properties of BC due to its anti-inflammatory and antimicrobial properties [4]. Thanks to BC's versatile characteristics, it is aimed to be used for the first time in wound dressing applications, modified with sage essential oil, which has anti-inflammatory activity. The BC to be used in the study was obtained from waste produced during kombucha tea production. Subsequently, BC was impregnated with sage oil. Fourier Transform Infrared Spectroscopy (FTIR) was used to determine the thermal and chemical properties of the obtained BC impregnated with sage oil (SOBC). The antibacterial properties of sage oil against *Escherichia Coli* and *Staphylococcus Aureus* bacteria were evaluated. The water retention capacity of the resulting products was measured.

This study aims to enhance the wound-healing properties of SOBC and utilize it in wound dressing applications. Additionally, it aims to increase economic sustainability by making the cellulose sources used in wound dressing production more economical. The study also intends to reduce costs and make wound dressings more accessible by using BC.

Acknowledgment: We would like to thank TUBITAK for supporting this study under the 2209 – A University Students Research Projects Support Program.

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ENHANCED PHOTOCATALYTIC DEGRADATION OF AZO DYE WITH ZNO NANOPARTICLES UNDER VISIBLE LIGHT. PHYTOTOXICITY EVALUATION ON A COMMON PLANT SPECIES

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ABSTRACT

The presence of synthetic dyes, such as tartrazine, in wastewater raises significant environmental and public health concerns due to their persistence, bioaccumulation potential, and toxicological effects on aquatic ecosystems and human health. Addressing these challenges calls for innovative approaches for effective dye removal and degradation. This study investigates the potential of photocatalysis as a sustainable method for degrading tartrazine using zinc oxide (ZnO) nanoparticles activated by visible light. ZnO nanoparticles were synthesized and employed as a photocatalyst in aqueous solutions of tartrazine at varying concentrations, using a catalyst loading of 0.8 g/L. The visible light-activated process generated electron-hole pairs in the ZnO nanoparticles, initiating redox reactions that broke down the tartrazine molecules.

To assess the environmental safety of this degradation process, phytotoxicity tests were conducted on a common plant species, *Lepidium sativum*, to evaluate the potential toxicity of by-products formed during photocatalytic treatment. The results showed complete degradation of tartrazine at a concentration of 1 mg/L within 60 minutes, demonstrating the high efficiency of ZnO nanoparticles under visible light. Moreover, phytotoxicity tests revealed that the growth and development of seeds in treated solutions were comparable to those in control samples, indicating that the degradation by-products were less harmful than untreated tartrazine.

These findings highlight the dual advantages of the ZnO/visible light photocatalytic system: it effectively degrades tartrazine while producing less toxic secondary compounds, making it an environmentally friendly solution for treating dye-contaminated wastewater. This study contributes to the growing body of research supporting the use of photocatalysis in environmental remediation and underscores its potential as a sustainable strategy for tackling synthetic dye pollution in aquatic environments. Additionally, the use of plant-based phytotoxicity assays serves as a valuable tool for assessing the ecological safety of advanced oxidation processes.

Keywords: photocatalysis, synthetic dyes, visible-light degradation, phytotoxicity.

NANOPARTICLE-BASED DRUG DELIVERY SYSTEMS FOR TARGETED CANCER THERAPY

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ABSTRACT

Targeted cancer therapy has advanced significantly with the use of nanoparticle-based drug delivery systems, which aim to increase the efficacy and specificity of available treatment options. By utilising the special qualities of nanoparticles-such as size, surface charge, and functionalization-these inventive systems make it possible to precisely deliver therapeutic chemicals to cancerous cells while protecting healthy tissues. This study offers a thorough analysis of the several kinds of nanoparticles used in cancer treatment, such as polymeric, dendrimer, and liposome nanoparticles, and describes how they work to target and penetrate tumours. We also look at the difficulties that are currently being encountered in the development and clinical application of systems based on nanoparticles, including scalability, biocompatibility, and regulatory barriers. Prospects for the future in this field are highlighted, emphasising the possibility of improved treatment effectiveness, less side effects, and new uses in personalised medicine. In the end, drug delivery systems based on nanoparticles have a lot of potential to transform cancer treatment strategies and enhance patient outcomes.

Keywords: Cancer Therapy, EPR Effect, Stokes-Einstein, Nanoparticle Diffusion, Polymeric

SYNTHESIS AND ANALYSIS OF 3-AMINO-5-(2-METHYLPROPYL)-2-SULFANYLIDENEIMIDAZOLIDIN-4-ONE BASED ON THE HETEROCYCLIZATION REACTION

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ABSTRACT

Thiosemicarbazones are a class of compounds of major importance in human life due to the fact that they possess a wide range of medicinal properties such as antifungal, anticarcinogenic, antiproliferative that help in the preparation of drugs to treat diseases such as various types of cancer, leukemia, etc. Most of the drugs used in medical practice are organic substances. Recently, much attention has been paid to transition metal complexes as biologically active substances, 3*d* metal coordination compounds exhibit characteristics that make them excellent candidates as antimicrobial agents [1-3]. Branched-chain amino acids (BCAAs) are part of the treatment of hepatic encephalopathy (HE) and increase cerebral perfusion [4]. Leucine and isoleucine are a class of compounds of major importance in the treatment of various diseases, respectively due to these properties we aimed to synthesize thiosemicarbazones that can later be complexed with metal salts and compounds with antitumor, antifungal, and antiproliferative activities can be obtained. The synthesis of cyclic thiosemicarbazide (**II**) was carried out according to the following scheme to give a white solid compound.

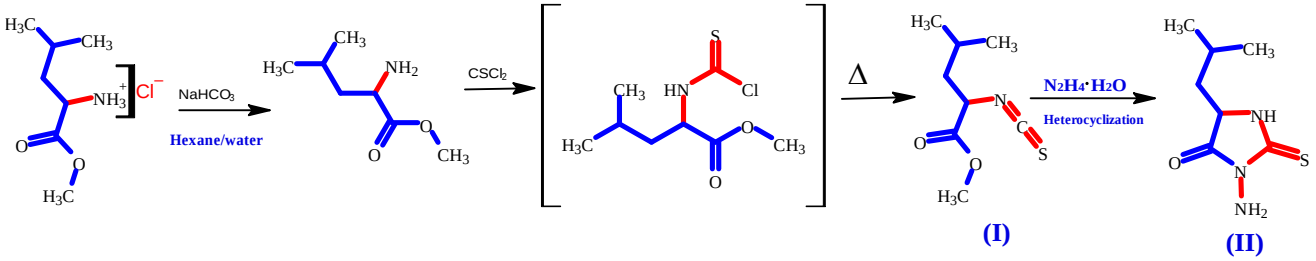

Figure 1. General synthetic scheme for the synthesis of 3-amino-5-(2-methylpropyl)-2-sulfanylideneimidazolidin-4-one (*name preferred* leucine-thiosemicarbazide).

Cyclic thiosemicarbazide (II) is obtained by mixing isoleucine hydrochloride solution in $NaHCO_3$ solution to which thiophosgene is added dropwise in a cooling and stirring system monitoring the TLC reaction. Stir for about 6 hours until the thiophosgene color disappears. The interaction of isothiocyanate (**I**) with hydrazine monohydrate in ethanol leads to the 'intramolecular heterocyclization' reaction with the

formation of the final product (**II**). The synthesis product (**II**) is a white crystalline substance, confirmed by IR, NMR, and X-rays.

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NEW INSIGHTS INTO THE CYTOTOXICITY AND BIOCOMPATIBILITY OF THREE TYPES OF ENDODONTIC MATERIALS – A COMPARATIVE PILOT STUDY

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ABSTRACT

Assessing the biocompatibility of endodontic root-end filling materials through cell line G-292 human osteoblasts responses is both essential and of utmost importance. This study aimed to explore the cytotoxicity, and the biocompatibility of cells incubated for 24 hours & 48 hours with the following types of endodontic materials: Ketac Molar EasyMix (glass ionomer cement), AH Plus (epoxy resin sealer), GuttaFlow 2 (silicone-based sealer).

The cell line (G-292) is represented by osteosarcoma cells. The material samples have been obtained according to the manufacturer's technical specifications. The following assays were performed: for cell viability – MTT ((3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide)); for cytotoxicity – Griess Test (NO – Nitric Oxide) and LDH (Lactate Dehydrogenase).

Our results revealed that:

– in the case of GuttaFlow 2 we did not notice significant differences in terms of the viability test (MTT) for both incubation times, compared to the control, but regarding the Griess test, after 48 hours the NO level increased by 20% vs. control.

– regarding AH Plus, viability was significantly reduced, 92% and 88% for 24 and 48 hours respectively; correlated with these results, LDH levels increased approximately 4 times at 24 hours and 3 times after 48 hours compared to the control; the Griess test revealed an increment by 47% and 49% of NO level after 24 and 48 hours, respectively, compared to the control.

– concerning Ketac Molar, according to the MTT test, the viability was reduced by approximately 30% compared to the control; the results of the Griess test showed an increase of 18% and 27% for 24 and 48 hours, respectively, vs control.

As far as we know, there are few studies that compare the biocompatibility of these three classes of endodontic materials. Our results have illustrated that the best biocompatibility was demonstrated by the

material belonging to the category of silicone-based sealers, GuttaFlow 2. Our results may offer valuable insights into the biocompatibility of glass ionomer cements, epoxy resin sealers and silicone-based sealers.

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ANTICORROSIVE CAPACITY OF *MENTHA PULEGIUM L.*, AGAINST MILD STEEL IN SULFURIC ENVIRONMENT

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ABSTRACT

The natural phenomenon of corrosion costs many industries millions of dollars. This is why the addition of inhibitors is considered one of the methods used to reduce this phenomenon. In generally speaking, effective corrosion inhibitors are synthetic chemicals that can be harmful to human health and the environment. Nevertheless, an inhibitor must meet an essential criterion, namely its effect on humans and the environment. Many researchers have therefore turned their attention to the application of non-toxic inhibitors known as “green inhibitors”. These are organic natural compounds such as plant extracts, essential oils, etc., because of their availability, cost and, at the same time, they do not present any negative effects on the environment or danger to human health.

The present study is part of a long and important line of research aimed at enhancing the value of natural plant resources, in particular aromatic and medicinal plants from Morocco. As part of this project, we chose to study the anticorrosive power of *Mentha pulegium* L (MP) against mild steel in a 0.5M sulfuric medium, varying two key parameters: concentration and temperature. The study was carried out using a combination of stationary and transient electrochemical methods. The inhibitory effect of this oil on mild steel corrosion in a 0.5 M H_2SO_4 solution showed mixed behavior. We were able to show that the essential oil of MP inhibits mild steel corrosion in the solution tested with a significant efficacy that increases with oil concentration, reaching a maximum of 75,80%. This inhibitory efficacy is dependent on essential oil concentration and temperature.

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NOPAL CACTUS MUCILAGE AS A SUSTAINABLE CORROSION INHIBITOR FOR BRONZE B66 IN SALINE ENVIRONMENTS

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ABSTRACT

Increasing attention is being directed towards natural plant extracts as sustainable, cost-effective alternatives to traditional corrosion inhibitors. This study explores the potential of mucilage extracted from *Opuntia dillenii* (Nopal cactus) to mitigate corrosion on bronze B66 surface exposed to a 3.5% NaCl solution. A comprehensive set of analytical techniques, including weight loss measurements, electrochemical impedance spectroscopy (EIS), and potentiodynamic polarization (PDP), was applied to evaluate the effectiveness of the mucilage extract in reducing corrosion rates.

The results indicate an inhibition efficiency of 91%, with evidence suggesting that the mucilage acts as a mixed-type inhibitor, hindering both anodic and cathodic corrosion processes. Adsorption studies reveal that the interaction between the mucilage and the bronze surface follows Langmuir's isotherm. Key thermodynamic parameters, including activation energy, enthalpy of dissolution, and Gibbs free energy, were calculated and analyzed to provide further insight into the inhibition mechanism.

Additional surface analyses using scanning electron microscopy and energy-dispersive X-ray spectroscopy (SEM/EDX) identified a protective film on the bronze, while UV-Vis spectroscopy highlighted the active chemical components responsible for the inhibition. Molecular dynamics (MD) and density functional theory (DFT) simulations further elucidated atomic-level interactions between the bronze substrate and the mucilage, pinpointing potential adsorption sites and energetic profiles.

These findings collectively suggest that *Opuntia dillenii* mucilage is a potent, eco-friendly inhibitor for mitigating bronze B66 corrosion, particularly in environments with high chloride concentrations.

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ADSORPTION OF ORGANIC CONTAMINANTS ON SORBENTS DERIVED FROM RICE HUSK ASH

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ABSTRACT

The development of cost-effective and sustainable sorbents for the removal of organic contaminants from wastewater remains a significant challenge. Organic pollutants such as p-cresol are commonly found in industrial and municipal wastewater, posing threats to environmental and human health [1]. Meanwhile, the global production of approximately 140 million tons of rice husk (RH) annually results in a largely underutilized agricultural waste product, causing environmental harm when burned or discarded [2].

In this study, sorbents derived from RH ash, including carbon and silica materials, were prepared and characterized. The synthesis involved the separation of RH ash into silica and carbon fractions, followed by modification of carbon sorbents using hydrothermal treatment with ammonia to introduce nitrogen-containing functional groups. The sorbents were evaluated for their efficiency in removing p-cresol and indoxyl sulfate from aqueous solutions. Carbon sorbents demonstrated high adsorption capacities (e.g., maximum adsorption capacity of **67 mg/g** for p-cresol), while silica sorbents showed negligible adsorption under the studied conditions. The introduction of nitrogen-containing groups on carbon surfaces significantly enhanced their adsorption performance for indoxyl sulfate, as evidenced by improved adsorption isotherms and kinetic behavior.

The kinetics of p-cresol adsorption were studied on carbon sorbents derived from RH ash. Theoretical calculations were performed based on diffusion equations and pseudo-first-order and pseudo-second-order models, confirming the applicability of the latter.

The findings highlight the potential of RH-derived sorbents, particularly modified carbon materials, for addressing the pressing need for cost-effective and sustainable solutions in water purification. Future work will focus on optimizing these sorbents for broader applications, including pilot-scale studies in wastewater treatment.

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SYNTHESIS, SPECTRAL ANALYSIS AND MOLECULAR DOCKING OF N-(prop-2-en-1-yl)-2-[4-(2,6,6-Trimethylcyclohex-1-en-1-yl)but-3-en-2-ylidene]Hydrazine-1-Carbothioamide WITH ANTICANCER POTENTIAL

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ABSTRACT

Studies have shown that thiosemicarbazones possess antibacterial, antifungal, anti-inflammatory and anticancer effects, and their efficacy depends crucially on the structure of the substituents. Of particular interest is functionalization of naturally occurring compounds, such as β-ionone – a cyclic terpenoid that forms the basic structure of retinol, β-carotene and vitamin A, which has low toxicity and significant biological activity. β-Ionone is a volatile aromatic compound used as a component in perfumery. In particular, β-ionone has attracted the attention of researchers due to its ability to selectively kill only cancer cells [1]. There is a prospect of synthesizing novel thiosemicarbazones based on β-ionone. Studies have shown that β-ionone and its derivatives may exhibit significant pharmacological activities such as antileishmanial, anti-inflammatory and antimicrobial activities [2]. In this work, we synthesized a new thiosemicarbazone in base of β-Ionone, which also contains an allyl moiety. The structure of the synthesised compound was confirmed by ^{1}H and ^{13}C NMR spectroscopy.

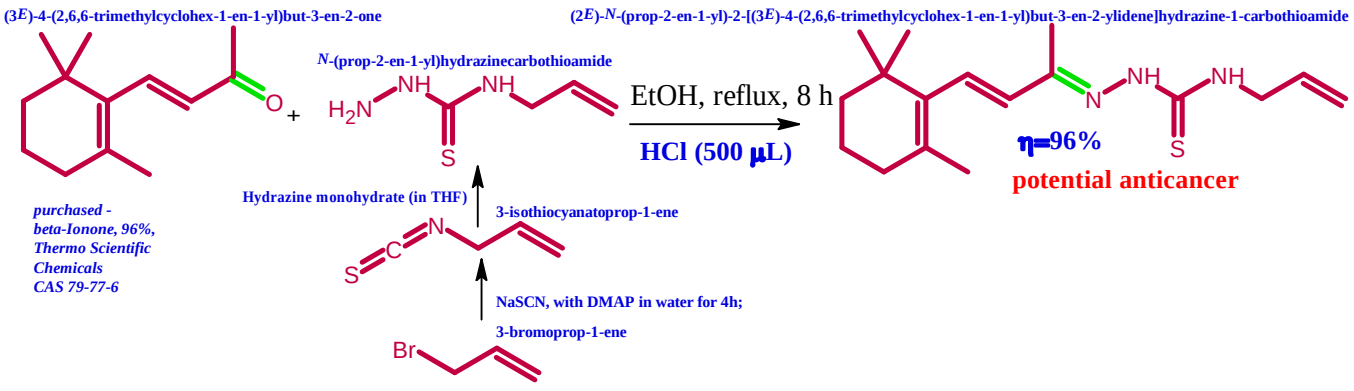

Figure 1. Synthesis scheme of desired thiosemicarbazone.

The molecular docking method was used for the primary evaluation of the biological properties of x. As target proteins were selected: DNA Gyrase (target protein for many antibiotics), Topoisomerase II α (its inhibition is associated with anticancer activity) and HER 2 (inhibitors of which are used to treat HER 2 positive breast cancer). The binding affinity for DNA Gyrase was found to be (-6.1) kcal/mol, for Topoisomerase II α – (-7.0) kcal/mol, and for HER 2 – (-7.1) kcal/mol. In general, the values in all three

cases are weaker than those of known inhibitors. Nevertheless, they are not too bad, which means that it still makes sense to carry out real tests of this substance.

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CIRCULAR ECONOMY PRINCIPLES APPLIED IN THE HOSPITALITY INDUSTRY TO REDUCE FOOD WASTE

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ABSTRACT

The tourism sector needs to progressively transition and implement sustainable practices that build on innovation and digitization by 2030, with an emphasis on enhancing local traditions and customs, mitigating the socio-economic impact on community resources, diversifying economic activities by promoting internal and regional tourism, and creating partnerships at regional, national and international levels. Our study examines the use of circular economy principles in the hospitality industry to minimize food waste, reduce greenhouse gas emissions, and foster sustainable development goals by conducting an extensive literature review to assess existing circular economy frameworks in the tourism sector. According to FAO, one-third of the food sources produced for consumption are either wasted or not utilized. The hospitality industry can contribute to these food losses through irresponsible consumption or a sub-optimized supply chain. Tourism has a vital role to play in the creation and implementation of new strategies to reduce food waste globally, due to the influence that the hospitality industry has on the use of food in various activities or services, such as accommodation and food services, thereby increasing the profitability of companies operating in this sector. Promoting local food products can bring significant economic benefits to a region, especially if integrated into the tourism supply chain. In this way, regions can preserve their local identity, new jobs can be created, and tourism experiences are enhanced and become increasingly diversified. In 2022, the WTO proposed a strategy for the tourism industry which aims to promote a more sustainable economic system in this sector. This strategy proposes to stakeholders in the industry to set targets to reduce food waste by monitoring progress, to implement measures to reduce their waste by collaborating with their suppliers to reduce food waste among tourists, and to disseminate progress widely to encourage other businesses to implement this approach. The results of our study indicate that incorporating circular economy practices can significantly reduce environmental impacts and promote responsible tourism practices. By transitioning from linear to circular systems, tourism service providers can increase food resource recovery and reduce food waste.

FABRICATION AND CHARACTERIZATION OF 3D PRINTED SA/PVA/XG COMPOSITE FOR WOUND DRESSING APPLICATIONS

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ABSTRACT

Tissue engineering examines the regeneration and restructuring of damaged tissues by adapting the stages of cell adhesion and proliferation that enable the formation of new tissues to the appropriate 3D microenvironment. [1] In this field, artificial biomaterials that mimic the natural extracellular structure are produced by using many types of materials and applying production methods. Among the artificial biomaterial studies in which these various methods are applied, there are studies on wound dressings produced with 3D printing methods.

The materials to be used in wound dressing studies produced by 3D printing methods must be non-toxic, biocompatible, biodegradable, have appropriate mechanical and thermal properties and appropriate properties for the production method to be used.

In this study, the mechanical, thermal and biological properties of the composite biomaterial obtained by applying three-dimensional printing technology with a mixture of Sodium alginate, Polyvinyl alcohol and Xanthan Gum polymer obtained in different mixing ratios will be examined.

Sodium alginate (SA) is a natural polymer which is non-toxic, biocompatible and biodegradable. It has good printability and is therefore frequently used in mixtures prepared for three-dimensional (3D) printing in tissue engineering applications. However, pure SA hydrogel has unstable mechanical properties. [2] Polyvinyl alcohol polymer will be used to improve the mechanical properties of sodium alginate to be used in the wound dressing scaffold. PVA-based hydrogels; Besides it contains multiple hydroxyl groups that can be easily excited to form hydrogen bonds, it has low cost, low toxicity, high mechanical strength, excellent biocompatibility and chemical stability, on the other hand, it is not mechanically flexible enough and often shows brittleness. [3] Therefore, PVA is often mixed with other polymers to provide hydrogels the necessary properties. XG is rich in hydroxyl, carboxyl and other functional groups, making it a polymer capable of interacting with PVA. In addition, XG polymer has the ability to create high reductions in inflammatory responses thanks to its negatively charged carboxyl groups and to inhibit bacterial growth by being effective in fibroblast adhesion. [4] Its biocompatibility indicates that it is a polymer that can be used in wound dressing studies.

It is aimed to produce and analyze different combinations of sodium alginate for good printability, polyvinyl alcohol to improve mechanical properties, and xanthan gum polymers for flexibility, good adhesion and cell viability, using the 3D printing method.

In the proposed study, composites of sodium alginate, polyvinyl alcohol and xanthan gum polymers in various ratios will be produced using the 3D printing method and the best ratios will be determined by analyzing them with a series of characterization methods. UTM (Universal Testing Machine) to determine the mechanical properties of the produced composite samples, DSC (Differential Scanning Calorimetry) to

determine the thermal properties, in vitro cytotoxicity to test the biological compatibility of the produced scaffolds, swelling-degradation to analyze the hydrophilic properties of the material, and SEM (Scanning Electron Microscope) to analyze the morphological properties, will be used.

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A TISSUE SCAFFOLD ENRICHED WITH CISPLATIN AND CRANBERRY PLANT IN GELMA/HAP FOR BONE CANCER

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ABSTRACT

This study aims to present an innovative approach to bone cancer treatment by using 3D printing technology and biomaterials engineering, specifically focusing on the development of a Gelatin Methacryloyl/ Hydroxyapatite/Hyaluronic Acid (GelMA/Hap/HA) based scaffold. The main objective was to optimize the synthesis conditions of GelMA to reduce toxicity and to create a suitable environment for osteoblast adhesion and proliferation. The scaffold was enriched with cisplatin and cranberry extract (*Vaccinium Oxycoccos*) in order to support the growth of cells while enhancing the therapeutic efficacy in cancer treatment.

In line with this goal, three groups with varying Hap concentrations were prepared to determine the optimal biomaterial mixture. These formulations were used to fabricate 3D scaffolds via Digital Light Processing (DLP) technology. The biocompatibility of the scaffolds was tested in vitro using osteoblast cells. In addition, the combined effects of cranberry extract and cisplatin on osteoblast cells were assessed through IC_{50} analyses and cell viability tests. The results demonstrated that cranberry extract and cisplatin effectively suppressed the growth of osteosarcoma cells, suggesting that this combination could be a promising treatment option for bone cancer.

Material characterization was conducted through FTIR analysis to confirm the successful incorporation of the biomaterials. The spectra showed characteristic peaks, indicating the chemical bonding and compatibility of the scaffold components. Furthermore, the scaffold demonstrated structural stability, showing no significant degradation after 7 days in a cell culture medium.

This innovative approach offers an alternative to traditional bone cancer therapies, aiming to reduce treatment costs and develop new methods suitable for clinical use. The study also highlights the potential use of cranberry extract in tissue engineering. By combining cisplatin and cranberry extract with a scaffold that mimics the structural properties of bone tissue, this study contributes to the development of advanced biomaterials for cancer treatment.

CHITOSAN-BASED SMART AND VERSATILE MATERIALS

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ABSTRACT

Chitosan based-materials still continue to increase the attention from researchers. Their successful applications in biotechnology, dermatocosmetics, environmental or healthcare domains make these materials very desirable. Chitosan represents a major pioneer most of all because of its polymorphism [1,2]. Characterized by a cationic nature profile, this fact allows scientists to develop gentle synthesis procedures for designing novel chitosan-based materials such as microspheres, nanoparticles, thin substrates, immobilization supports for enzymes or as cosmeceutical ingredients for topical applications [3,4].

Developing biomaterials starts with the possibility of functionalized chitosan with a large number of crosslinkers such as phytic acid (PA), polyacrylic acid (PAA) or hydrolyzed collagen (HCol) for obtaining patterns with versatile applications. Moreover, molecular dynamics can help in understanding the interactions established between polymeric chains with crosslinker molecules in order to predict and analyze supramolecular systems. Our group obtained free and loaded chitosan-based nanoparticles investigated further by AFM microscopy, dynamic light scattering (DLS), infrared, UV-Vis and fluorescence spectroscopies. Additionally, computational models for chitosan with atomistic details were created during simulations to explore binding parameters and hydrogen bonds. Besides that, chitosan-based microparticles were also synthesized for enzyme immobilization on mixed polymeric supports for dye removal with application in wastewater treatments. Another study directive is oriented towards cosmeceutical applications of thin polymeric substrates and topical formulations for skin therapy.

In conclusion, nanoparticles based on chitosan and phytic acid were successfully synthesized and their morphological features were investigated. Furthermore, microspheres based on chitosan and polyacrylic acid were considered to be a promising support material for enzyme immobilization with applications in sustainable water treatments. Last but not least, a topical formulation based on chitosan was investigated through experimental methods for further molecular skin models.

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THE PERSPECTIVES ON THE USE OF AUGMENTED REALITY IN ONCOLOGY THROUGH THE 3D-PRINTING TECHNOLOGIES

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ABSTRACT

Background. Augmented reality (AR) represents an innovative method of visualizing objects in a multidimensional plane with the help of special applications compatible with mobile devices. Along with the development of AR, its role in the oncological field was also emphasized, for didactic, prophylactic and therapeutic purposes.

Objective of the study. Establishment of the main achievements and directions of use of augmented reality together with the 3D-printing technologies and their perspectives for implementation and use in oncology.

Material and Methods. A literature review was performed using scientific articles from the PubMed, NCBI, Science Direct databases up to 10 years. An online platform was used to store and visualize models of oncology-specific 3D-printable molecules and tumors through AR.

Results. There were analyzed the directions of implementation of AR using 3D-printing technologies (3D-PT) in oncology. Through Echo3D online platform, the copyright free model of the p53 protein molecule was uploaded, then converted and visualized in AR format, as well as the 3D-printable models of gastric, liver and breast cancer tumors, obtained with CT scanning. These interactive models visualized through augmented reality with 3D-PT can serve a theoretical-practical sport during the study in the oncology module but also in the planning of the surgical approach in the preoperative management for a better acquisition of the anatomical-structural peculiarities of the tumors compared to the adjacent structures.

Conclusion. Augmented reality, in combination with the 3D-printing technologies, denotes high perspectives on the development of personalized medicine in oncology, ensuring a multidisciplinary, individualized, interactive and precise therapeutic approach.

Keywords: Augmented reality, 3D-printing, oncology, personalized medicine.

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COVALENTLY CROSS-LINKED CARBON NANOSTRUCTURES: HETEROSUBSITUTED NANOTUBES/FEW-LAYER GRAPHENE NANOFLAKES HYBRIDS

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ABSTRACT

Covalently cross-linked carbon structures are rather promising materials for incorporation into various polymer matrices, as they offer new possibilities for tailoring the properties of the resulting material. Heterosubstitution of some carbon atoms in their structures allows for changes in two types of properties: acid-base surface potential and the number of electrons in the system. The introduction of B, N, P, S into carbon nanostructures has been described previously [1]. The ability to be covalently cross-linked, even for different forms of carbon, demonstrates a good possibility for new material design. The present work deals with the synthesis of heterosubstituted derivatives of multi-walled carbon nanotubes (MWCNTs) and few-layer graphene nanoflakes (GNF), their surface functionalization and covalent cross-linking for further utilization in antifouling paints.

In this study, oxidized N- and P-doped carbon nanomaterials (CNM) were also covalently cross-linked to create new advanced materials. Heterosubstituted CNM were prepared according to [*2*]. Functionalization of their surface was performed as described [3]. Cross-linking was realized through the formation of covalent bonds via (3-aminopropyl)triethoxysilane fragments grafted onto the surface of carbon nanostructures through carboxyl groups [4]. To obtain the material, a dispersion of oxidized multi-walled carbon nanotubes (O-MWCNTs) in ethanol was treated with (3-aminopropyl)triethoxysilane (APTES) with the addition of formic acid to maintain the pH at 4.0–4.5. The reaction was conducted under heating to 60ºC and stirring in an inert atmosphere (Ar) for 24 hours. The resulting product was thoroughly washed with distilled water and dried at 50ºC for 8 hours (Fig. 1).

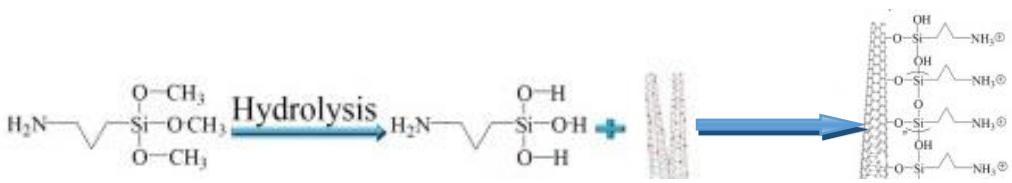

Figure 1. Schematic representation of the processes occurring during the interaction of O-MWCNTs with (3-aminopropyl)triethoxysilane [5].

The cross-linking of N- and P- heterosubstituted MWCNTs and few-layer graphene nanoflakes (GNF) was carried out by mixing equal volumes of oxidized GNF (O-GNF) and O-MWCNT+APTES dispersions in N,N-dimethylacetamide, followed by ultrasonic treatment with cooling for 1 hour.

Transmission electron microscopy (TEM) images (Fig. 2) show the cross-linked fragments.

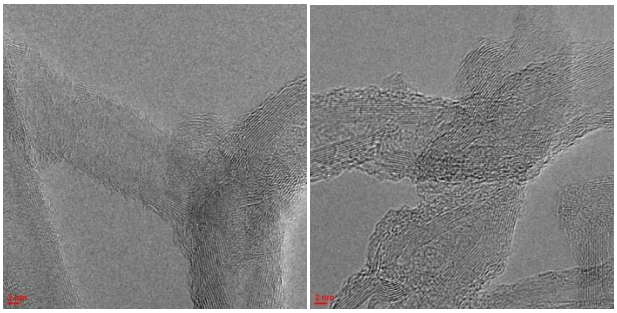

Figure 2. TEM images of the O-MWCNT+APTES+O-GNF.

Materials were also studied by differential scanning calorimetry (DSC). From the DSC curves (Fig. 3), it can be seen that cross-linked O-MWCNT and O-GNF undergo thermal degradation at lower temperatures than cross-linked O-MWCNT, which is due to a more defective structure because of oxidation and heterosubstitution.

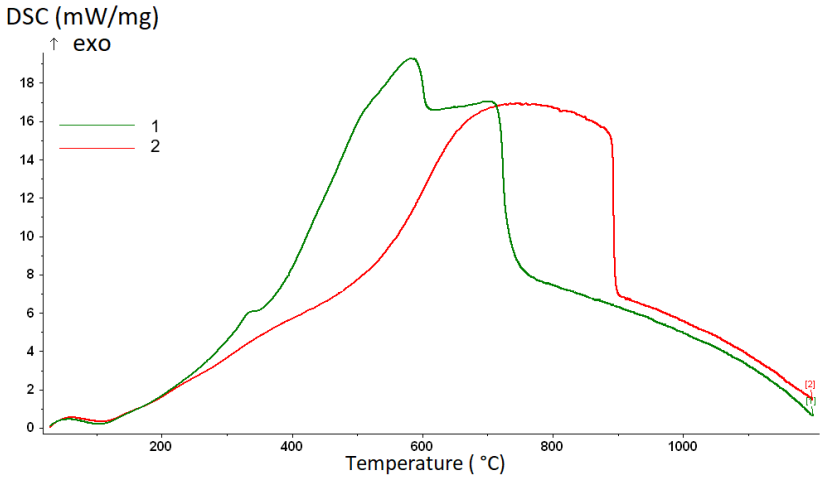

Figure 3. Comparison of DSC combustion profiles for the O-MWCNT+APTES (1) and O-MWCNT+APTES+O-GNF (2) samples.

Carbonization of the obtained material in the thermogravimetric analyzer furnace (heating from 40 to 700°C at 40°C/min, Ar gas flow 8 mL/min, protective gas Ar 8 mL/min) and examination of the final product by TEM revealed cross-links between O-MWCNT and O-GNF (Fig. 4) as well. Elemental CHNSO analysis and oxidation of the final materials during thermoanalytical investigation with mass-spectral control of outgoing gases confirmed the presence of heteroatoms.

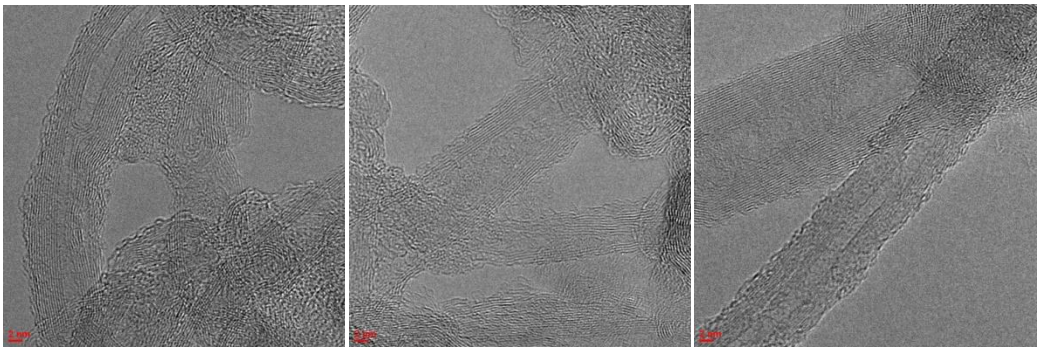

Figure 4. TEM images of the carbonized O-MWCNT+APTES+O-GNF sample.

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PRODUCTION OF CHITOSAN-PVA COATED VITAMIN E AND EPHEDRINE MICROPARTICLES FOR THE TREATMENT OF NARCOLEPSY

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ABSTRACT

Narcolepsy; is a chronic neurological disorder characterized by disruption of the sleep cycle, daytime sleepiness, cataplexy, hallucination, and sleep paralysis. The disease occurs as a result of the disruption of molecular mechanisms in the lateral hypothalamus. Although, over 3 million people are shown to suffer from Narcolepsy today, important data reveals that approximately 50% of today's narcolepsy cases can be diagnosed due to deficiencies in specific diagnosis. Currently, narcolepsy has no curative or disease progression preventive pharmaceutical or behavioral therapies. Available treatments only consist of symptom-based medications that have drawbacks including having dangerous systemic side effects and not being able to provide the desired effect in every individual. According to a recent statistical study, %37 of narcolepsy patients take antidepressants due to depression and anxiety or having poor psychosocial sufficiency.

Recently, new treatment approaches have emerged due to the obvious need for development. Intranasal polymeric treatments are increasing significantly in other central nervous system diseases due to their ability to reduce systemic side effects and more accurate targeting. Even though intranasal approaches to narcolepsy are limited, these studies have yielded results confirming the advantages of intranasal application in the treatment of narcolepsy. In this study, a composite chitosan-PVA particle loaded with Ephedrine and Vitamin E is proposed using the electro-spraying technique for the treatment of sleep disorders that develop due to the orexinergic system, especially narcolepsy. Thanks to the antioxidant and orexin-like neuroprotectant properties of vitamin E and the central stimulating and anticataleptic effect of Ephedrine, a highly biocompatible design that can provide a cure to the disease has been achieved. In order to increase intranasal bioefficiency in the hypothalamus where orexin cells are concentrated and to obtain a more stable and long-term effect.

Characterization of the produced particles are conducted to investigate and optimize the interaction between particles and the brain target site. By combining with in vitro release test, UV-VIS (Ultraviolet Visible Spectrometry) has been used for the determination of encapsulation efficiency and release profile. Using the FT-IR (Fourier Transform Infrared Spectroscopy) technique, the bioactive component loading status in particles were determined. Furthermore, antibacterial and antioxidant tests are conducted to detect the biocompatibility and the desired impact on the intracellular reduction of oxygen. Finally, the images obtained by SEM(Scannin Electron Microscopy) provided significant information regarding particle size and morphology.

With its ease of application and natural content, it has a formulation that every group of patients will prefer, and the polymer-coated drug release mechanism we designed is designed to provide long-term effect and maximum efficiency. In the follow-up of the success of the intranasal compatible nanoparticle technique proposed, it will allow the production of numerous studies on the treatment of many different central nervous system diseases with different active substances.

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SYNTHESIS AND CHARACTERIZATION OF GRAPHENE OXIDE-BASED ANTICANCER DRUG COMBINATION FUNCTIONALIZED WITH FOLIC ACID AS A NANOCARRIER FOR METHOTREXATE TARGETED DELIVERY

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ABSTRACT

In recent years, graphene has emerged as a key component in cancer research. Additionally, graphene and its derivatives are being considered as drug delivery system carriers. In this work, we developed a drug delivery system that uses graphene oxide (GO) to administer methotrexate (MTX) loaded with folic acid (FA). First, graphene oxide was produced from graphite by the modified Hummers method [1]. The graphite-derived GO was linked to MTX and FA [2,3]. Differential calorimetric analysis (DSC), scanning electron microscopy (SEM), transmission electron microscopy (TEM), zeta potential analysis, dimension measurement (DLS) studies, and Fourier transform infrared spectroscopy (FTIR) were used to characterize the MTX/FA/GO drug delivery system and its individual components. SEM and TEM pictures validated the nanosheet structure of GO derived from graphite, demonstrating that MTX/FA binding to GO converted the two-dimensional structure into a three-dimensional configuration [4,5]. The FTIR and DSC analyses verified that oxygen atoms were attached to graphene oxide (GO), resulting in the creation of carboxylic, hydroxyl, epoxide, and carbonyl groups due to the oxidation of graphite, hence confirming the successful synthesis of GO [6,7]. Furthermore, our research has demonstrated that MTX and FA physicochemically interact with the structure of GO. The in vitro Franz diffusion assay was conducted as a release kinetics evaluation. It was found that the Higuchi model and 0.9785 were the mathematical models for the release kinetics and correlation coefficient (R2) of MTX-loaded GO/FA nanomaterials, respectively [8]. According to the findings, the synthesized MTX/FA/GO material offers promising potential for use as a drug delivery system in targeted therapy for cancer cells [9].

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UTILIZATION OF 3D PRINTED CARBOXYMETHYL CELLULOSE, PECTIN, AND POLYVINYL ALCOHOL-BASED BIO-SCAFFOLDS IN WOUND HEALING

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ABSTRACT

The wound healing process necessitates the use of biocompatible and biodegradable scaffolds to address challenges such as tissue loss and infection risk. This project aims to develop a bio-scaffold composed of Carboxymethyl Cellulose (CMC), Pectin, and Polyvinyl Alcohol (PVA) to accelerate the wound healing process. Using 3D printing technology with the Axo BioPrinter, this structure is designed to maintain moisture balance, support cell growth, and reduce the risk of infection.

CMC contributes positively to wound healing through its water retention and controlled dissolution properties [1]. Pectin creates an environment that reduces inflammation with its antioxidant features while supporting cell proliferation [2]. PVA enhances the scaffold's stability by providing mechanical strength and facilitates cell adhesion due to its biocompatible nature [3]. The combination of these three materials has been chosen for their ability to form an ideal structure for wound healing.

The novelty of this study lies in the absence of prior research integrating CMC, Pectin, and PVA in a single scaffold. If successful, this project will pioneer the application of a wound-healing scaffold composed of these materials using 3D printing technology.

In the initial phase, CMC, Pectin, and PVA will be mixed in specific ratios to prepare a solution suitable for scaffold fabrication. The scaffolds will then be printed in a defined pattern using the Axo BioPrinter. The drug-free structures will undergo detailed biocompatibility and biomechanical characterization using Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), Differential Scanning Calorimetry (DSC), tensile testing, X-Ray Diffraction (XRD), cell culture testing, antibacterial analysis, and statistical evaluations. These analyses are critical to assess the suitability of the scaffolds for wound healing.

The project process will be meticulously planned and executed according to the outlined stages. Regular meetings and reporting will ensure effective monitoring and evaluation of progress. The results of this project are expected to present an innovative and effective approach to wound healing, leveraging the synergistic effects of CMC, Pectin, and PVA for faster and more sustainable wound recovery. This novel treatment method aims to outperform traditional approaches and make a significant contribution to the healthcare sector.

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TREATING VAGINAL YEAST INFECTIONS WITH 3D PRINTING-BASED AGENTS

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ABSTRACT

Vaginal fungal infections, commonly caused by Candida albicans, represent a widespread health issue among women of reproductive age. This project aims to compare the effectiveness of boric acid, an alternative treatment, with the conventional antifungal agent fluconazole. Additionally, this study seeks to develop a new therapeutic approach by creating a scaffold containing sodium alginate loaded with fluconazole and boric acid, a combination previously unreported in the literature.

Fluconazole, commonly used in treating fungal infections, is a well-established antifungal agent, while boric acid is another effective antifungal used in similar applications [1]. Gelatin, used to bind these two agents, serves as a protein source widely utilized across various industries. Sodium alginate, a natural anionic polysaccharide derived from brown seaweed found in cold waters, was chosen for its thickening and binding properties, as well as its good solubility with boric acid and fluconazole, making it a suitable polymer for this project [1].

The uniqueness of this study is demonstrated by the fact that sodium alginate scaffolds loaded with both boric acid and fluconazole have not been previously produced. Furthermore, the development of this project could result in the creation of the first 3D-printed antifungal wound dressing containing boric acid and fluconazole for the treatment of vaginal infections. This study, presenting a novel and original approach compared to traditional therapies, is planned in five stages.

In the first stage, fluconazole and boric acid, two effective drugs for treating vaginal fungal infections, were successfully selected. A scaffold design was then created, and scaffolds containing these drugs at specific concentrations were produced using 3D printing technology. The synergistic effect of the drugs was effectively observed through antimicrobial tests, and the characterization of drug-loaded scaffolds was conducted using Scanning Electron Microscopy (SEM), tensile testing, Fourier Transform Infrared (FTIR) Spectroscopy, Differential Scanning Calorimetry (DSC) Analysis, drug release testing, swelling, and degradation tests. These stages were critical for the project's success and were completed as planned.

The project process proceeded successfully according to the stages outlined in the previous paragraph. Each stage was meticulously planned and implemented. Regular meetings and reports were conducted to monitor progress, ensuring that the project stayed on track. The results achieved through this project have provided a promising and effective approach for the treatment of vaginal fungal infections. The synergistic effect of the boric acid and fluconazole combination offers more lasting and effective solutions. This study, which has assessed the advantages and efficacy of this new therapeutic approach compared to traditional treatments, represents a valuable contribution to the healthcare sector.

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EXPLORING THE ADSORPTION PROPERTIES OF MODIFIED ABIES MAROCANA TRAB. NEEDLES FOR METHYLENE BLUE DYE REMOVAL

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ABSTRACT

Dye-contaminated wastewater is a critical environmental concern due to its impact on water quality, which can make it unsuitable for domestic and agricultural use [1]. Synthetic dyes, such as methylene blue (MB), are resistant to natural degradation and can persist in aquatic ecosystems, posing risks to human health and biodiversity [2]. Conventional wastewater treatment methods, though effective, are often costly and can generate additional waste [3]. This study explores the use of biosorbents derived from *Abies marocana* as cost-effective and eco-friendly alternative for dye removal.

Abies marocana needles were chemically treated with sulfuric acid to improve their adsorption capabilities by modifying surface characteristics and functional groups. Detailed analyses confirmed structural changes post-treatment. Batch experiments optimized methylene blue (MB) removal, achieving 96.527 ± 0.017% efficiency at pH 8, with 400 mg of adsorbent, a 20 ppm dye concentration, a 60 min contact time, and a temperature of 25°C.

The adsorption of methylene blue (MB) onto modified *Abies marocana* needles (AMNS) follows a pseudo-second-order kinetic model, indicating chemisorption as the main mechanism. The Freundlich isotherm model describes the process well, suggesting multilayer adsorption on a heterogeneous surface. Thermodynamic analysis shows the process is exothermic and spontaneous, with negative enthalpy and Gibbs free energy values. Electrostatic attractions, hydrogen bonding, π-π interactions, and pore-filling enhance MB removal efficiency, highlighting AMNS as an effective adsorbent for wastewater treatment.

This study emphasizes the considerable potential of *Abies marocana* needles in environmental conservation, especially for the treatment of industrial effluents, providing a sustainable approach to reduce dye pollution in aquatic ecosystems.

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E- POSTERS

INNOVATIVE LIQUID CRYSTALLINE NANOCOATINGS FOR COMBATING IMPLANT RELATED INFECTIONS

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ABSTRACT

With increasing incidence of trauma surgery and demands for new implant materials there is also increasing risk of implant related infections. Infection rates for hip or knee surgery range from 0.5% to 3%, and biofilm formation complicates eradication efforts, as the extracellular matrix creates a more resistant environment for bacteria against antibiotics and immune responses[1,2]. Current clinical treatments involve debridement, long term antibiotic use and implant removal which significantly affects the costs and patient's comfort. However antibiotic therapy is not satisfactory in most cases due to emergence of antibiotic resistance and biofilm tolerance. Regarding the novel strategies, efforts are focusing on preventive measures to protect the implant surface from bacterial invasion. Recently advanced antibacterial coatings as a local antibiotic delivery system show promise due to their efficacy and controlled release. Biodegradable polymers, particularly hydrogels, are emphasized as drug carrying antibacterial coatings for their flexibility and biocompatibility, though they often lack long-lasting antibacterial efficacy[1]. Here we propose a self-assembly approach using liquid crystalline (LC) phases from biocompatible amphiphilic lipids for coating on implant surface. LC drug delivery systems are attractive due to their capabilities of various bioactive components including hydrophobic and hydrophilic drugs[3]. Titanium rods (Ø2 × 10 mm) and plates (10 × 10 mm^2) were coated with amphiphilic monoolein lipid preformulation containing Vancomycin at concentration range of 0.5–5 mg/ml via dip coating method. Coated substrates were left drying for removal of organic solvent and subsequently incubated with bacterial suspension of *Staphylococcus aureus* (ATCC 29213). Results demonstrated that dip coated samples prepared with all concentration of Vancomycin efficiently inhibiting the bacterial growth. Nonetheless there is still a need for full characterization to reveal the exacts structure. Our preliminary findings shows that this unique LC nanocoatings may provide a promising alternative to prevent bacterial colonization on implant surface and subsequent biofilm infections.

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FIGHT CAVITIES: NANO NATURAL AGENTS

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ABSTRACT

In this study, it is aimed to develop an alternative treatment method that can combat caries. For this, the first step is to obtain hydroxyapatite, which has been proven effective in many studies and imitates tooth enamel used in practice, by using seashells found as waste in the sea, with a simple and cost-effective method. With this production, it was thought that the inclusion of clove oil and thyme oil enriched with ZnO as antiseptic agents could increase the effectiveness of the treatment.

In the second stage, characterization tests were performed using Scanning Electron Microscope (SEM) and Fourier Transform Infrared (FTIR) Spectroscopy of hydroxyapatite powders prepared with the determined technique.

Finally, the produced powders were made into toothpaste; the effect on artificial caries was observed by applying it to hydroxyapatite-coated acrylic teeth.

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OREGANO ESSENTIAL OIL

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Volatile oils are products of secondary plant metabolism secreted by cells specialized for this purpose, distributed in different organs and stored in vacuoles, bags or secretory channels, or in gladular bristles, in the form of oily, volatile liquids with a pleasant, aromatic odor. They can accumulate in all plant organs, but in different quantities [1].

Oregano Volatile Oil (*Origani aetheroleum*)

Under this name are found the volatile oils obtained by the entrainment with water vapor of the floral sums coming from the oregano species of the *Lamiaceae family* (e.g. *Origanum vulgare* L. - sovârf) [1].

At the basis of the methods of extraction of volatile oils from vegetable products are their physicochemical properties, in particular their high vapour pressure and solubility in non-aqueous volatile solvents and fatty substances. The main extraction processes are: ***distillation and water vapor entrainment***, ***volatile solvent extraction***, ***supercritical fluid extraction***, ***pressing*** [1].

- ***Water vapor distillation***: it is done by passing water vapor through a vat filled with plants, the water vapor "searches" for essential oil bags inside the plant, after which, loaded with these molecules, they pass through a cooling pipe, where they condense. In the end, two products are obtained that are not miscible and that separate due to the composition and the difference in density. An oily one, which is the essential oil, and an aqueous one, which is floral water, loaded with aromatic molecules, but in a very low concentration [2].
- ***Supercritical fluid extraction***: is an environmentally friendly, non-polluting, but expensive solid-liquid extraction method in which the extraction solvent is replaced by a supercritical fluid. Liquid CO2 is usually used because it is a natural, non-flammable, chemically inert and non-toxic product. The most important property of supercritical fluids in extraction processes is given by the ability to adjust the solubilization power through physical parameters - temperature and pressure, so that a fluid in a supercritical state has the possibility to extract fine and fragile aromatic compounds, which do not support distillation with water vapor [1].

The control of the quality of the volatile oil consists in determining the organoleptic characteristics (appearance, color, taste, smell), miscibility in ethanol, physicochemical constants (density at 20°C, specific rotational power, acidity index, saponification index, etc.) or by performing analyzes to specify the chromatographic profile (gas chromatography/mass spectroscopy - GS/MS, thin layer chromatography - HPTLC) [2,3].

Composition of oregano volatile oil: it contains 50-80% monoterpene phenols, of which the majority is carvacrol (56-80% in *O. vulgare*), phenol-methyl-ethers (carvacrol methyl-ether), monoterpene hydrocarbons, sesquiterpenes [1,3]. **Action**: general tonic, anti-infective at respiratory, digestive, urogenital, bactericidal, fungicidal, virulicide, parasiticide, immunostimulatory [1]. **Uses**: respiratory infections, digestive infections, asthenia, hypotension [1]. **Toxicity**: caution is advised in dermal application as it can

become dermocaustic (by carvacrol and p-cymene) [1]. **Cronobiological**, is a positive oil (tonic, stimulant), with high efficacy if used during the ascending phases of the sun and moon [1].

The therapeutic activity of volatile oils is justified by the relationship **matter-energy-information. Matter** is represented by the chemical structure of the active constituents in volatile oils. These constituents are vectors of **negative or positive energy** and act as electron donors or acceptors, like all substances in the metabolic chain. From an **informational point of view**, oils transmit specific messages through nerve receptors (olfactory or gustatory), with memory, stomatal, emotional, affective and sexual correlations of great importance [1].

Conclusions. The choice of the appropriate extraction method is made according to the amount of volatile oil in the vegetable product, its location and physicochemical properties. The volatile oils circulating on the market are intended for aromatherapy, the cosmetics industry, perfumery and the agri-food industry. In pharmacies, oregano volatile oil can be used to obtain aromatic waters, liposols, aerosols, in various pharmaceutical preparations, giving them in addition to their pleasant, aromatic smell and taste and its therapeutic properties.

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COMPARATIVE ANALYSIS OF CERIUM DOPED AND CERIUM-STRONTIUM CO-DOPED BIOACTIVE GLASS: IMPROVED PROPERTIES AND PROSPECTIVE APPLICATIONS

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ABSTRACT

Bioactive glasses (BGs) have become significant in biomaterials research owing to their remarkable bioactivity, adjustable degradation rates, and capacity to promote bone regeneration and exhibit antimicrobial properties. This work examines the comparative characteristics and potential uses of cerium-doped (Ce-BG) and cerium-strontium co-doped (Ce-Sr-BG) bioactive glass, both produced using the sol-gel technique. Cerium (Ce), noted for its redox potential (Ce^{3+}/Ce^{4+}), imparts substantial antioxidant and antibacterial capabilities, whereas strontium (Sr), acknowledged for its capacity to promote osteogenesis and diminish bone resorption, provides synergistic advantages [1,2].

The co-doping of cerium and strontium is posited to enhance structural, thermal, and biological properties synergistically. X-ray diffraction (XRD) investigations of composition and structure verified the amorphous characteristics of both systems, with Ce-Sr-BG exhibiting reduced crystallinity and a more homogeneous distribution of doping elements within the silica matrix. Fourier-transform infrared spectroscopy (FTIR) demonstrated the successful integration of Ce and Sr ions, evidenced by distinctive bands indicative of their bonding locations inside the glass matrix. Scanning electron microscopy (SEM) demonstrated that Ce-Sr-BG samples possess increased nanoporosity (~50–65 nm) and surface roughness, both of which are essential for cellular adhesion and ion release. The thermal behavior examined via differential scanning calorimetry (DSC) demonstrated enhanced thermal stability and less weight loss in Ce-Sr-BG relative to Ce-BG, ascribed to the superior structural connectivity enabled by Sr. The combined release of Ce and Sr ions facilitates the control of reactive oxygen species (ROS) and the synthesis of hydroxyapatite, which are crucial for bone regeneration and antibacterial effectiveness. This comparative analysis demonstrates that co-doping with cerium and strontium markedly improves the multifunctionality of bioactive glasses, establishing Ce-Sr-BG as an exceptional candidate for bone tissue engineering, antibacterial surface coatings, and controlled drug delivery systems.

Future efforts will focus on optimizing the ratios of Ce and Sr to enhance the equilibrium among bioactivity, degradation kinetics, and mechanical strength, facilitating the creation of sophisticated biomaterials designed for intricate clinical issues.

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ECO-FRIENDLY SILVER-MODIFIED CLAY: COMBATING ISO SS BACTERIA AND ENHANCING MALACHITE GREEN DYE OXIDATION

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ABSTRACT

An innovative, simple, eco-friendly, and cost-effective method has been developed to produce a microporous material using naturally chemically modified bentonite with silver ions (BN-Ag^0). This material exhibits excellent catalytic activity against Malachite Green (MG) dye and bacteriostatic activity against a newly isolated bacterium from sewage sludge, named "*ISO SS*" , as well as *Escherichia coli (E. coli).* BN-Ag^0 was characterized using several advanced techniques, including energy-dispersive X-ray spectroscopy (EDX), scanning electron microscopy (SEM), Brunauer–Emmett–Teller (BET) method, Fourier-transform infrared (FTIR) spectroscopy, temperature programmed desorption (TPD), and X-ray diffraction (XRD). The bacterium *ISO SS* was isolated from anaerobically stabilized sludge. Comprehensive characterization identified the bacterial species. The new cationic clay-based nanomaterial showed significant antibacterial activity against *ISO SS* and good activity against *E. coli*. This bacteriostatic activity can help control waterborne diseases, especially in areas with poor sanitation. In the catalytic ozonation of MG dye, BN-Ag^0 significantly improves the oxidation time of the dye due to its superior adsorption and catalytic properties. Its excellent catalytic activity against MG dye, combined with its antibacterial properties, makes BN-Ag^0 highly effective for water purification. This can result in cleaner water sources, benefiting public health and easing the load on water treatment facilities. The catalytic and antibacterial activities of natural bentonite (BN) and BN-Ag^0 were analyzed using advanced techniques. The durability of the BN-Ag^0 catalyst was also assessed. These findings offer valuable insights for developing a high-quality microporous material with multiple functions. Developing an eco-friendly, cost-effective method to create microporous material supports sustainable practices. Using natural bentonite and silver ions, this study promotes environmentally friendly materials and reduces harmful chemicals. The material's dual role as a catalyst and antibacterial agent opens applications in wastewater treatment, chemical manufacturing, and environmental remediation. This research enhances scientific knowledge and offers practical solutions to environmental and public health challenges.

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HYDROGELS FROM PLASMA-MODIFIED STARCH SYNTHESIZED VIA ELECTRON BEAM IRRADIATION FOR WASTEWATER TREATMENT

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ABSTRACT

Environmental pollution caused by dye contaminants from industrial effluents demands the development of efficient novel wastewater treatment materials [1,2]. Starch-based hydrogels have gained attention due to their biocompatibility and potential for environmental applications [3,4]. This study explores the synthesis of plasma-treated starch hydrogels using electron beam irradiation to enhance their performance in water remediation. To refine their properties, starch samples were pre-treated with a low-pressure cold plasma source in air, under various vacuum times. The pre-treated samples were analyzed in terms of moisture content, relative crystallinity, particle size and their distribution, pH, and solubility. Subsequently, hydrogels were synthesized via electron beam crosslinking of starch grafted with acrylic acid, with irradiations performed under ambient conditions at doses of up to 14 kGy. The resulting hydrogels were characterized by their network parameters, gel fraction, spectral and morphological properties, and swelling behavior. Comparative analysis showed that hydrogels derived from plasma-treated starch exhibited superior crosslinking, higher gel fraction, and smaller mesh sizes than those synthesized from native starch. Moreover, the swelling capacity of the hydrogels in distilled water was reduced. The adsorption capacity for dye removal from synthetic wastewater was also evaluated at the laboratory scale. Compared to native starch hydrogels, plasma-treated starch hydrogels showed a notable 16% enhancement in dye adsorption efficiency. These findings point out the potential of plasma-treated starch hydrogels as efficient materials for wastewater treatment. Furthermore, combining cold plasma pre-treatment with electron beam synthesis is a viable strategy for producing a new generation of starch-based materials with enhanced environmental remediation potential.

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HYDROGELS FROM PLASMA-MODIFIED STARCH SYNTHESIZED VIA ELECTRON BEAM IRRADIATION FOR WASTEWATER TREATMENT

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ABSTRACT

Environmental pollution caused by dye contaminants from industrial effluents demands the development of efficient novel wastewater treatment materials [1,2]. Starch-based hydrogels have gained attention due to their biocompatibility and potential for environmental applications [3,4]. This study explores the synthesis of plasma-treated starch hydrogels using electron beam irradiation to enhance their performance in water remediation. To refine their properties, starch samples were pre-treated with a low-pressure cold plasma source in air, under various vacuum times. The pre-treated samples were analyzed in terms of moisture content, relative crystallinity, particle size and their distribution, pH, and solubility. Subsequently, hydrogels were synthesized via electron beam crosslinking of starch grafted with acrylic acid, with irradiations performed under ambient conditions at doses of up to 14 kGy. The resulting hydrogels were characterized by their network parameters, gel fraction, spectral and morphological properties, and swelling behavior. Comparative analysis showed that hydrogels derived from plasma-treated starch exhibited superior crosslinking, higher gel fraction, and smaller mesh sizes than those synthesized from native starch. Moreover, the swelling capacity of the hydrogels in distilled water was reduced. The adsorption capacity for dye removal from synthetic wastewater was also evaluated at the laboratory scale. Compared to native starch hydrogels, plasma-treated starch hydrogels showed a notable 16% enhancement in dye adsorption efficiency. These findings point out the potential of plasma-treated starch hydrogels as efficient materials for wastewater treatment. Furthermore, combining cold plasma pre-treatment with electron beam synthesis is a viable strategy for producing a new generation of starch-based materials with enhanced environmental remediation potential.

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COMBINING SPECTRAL METHODS, ACID-BASE TITRATIONS AND COMPUTATIONAL METHODS FOR ELUCIDATION OF METAL BINDING MECHANISMS ON ACTIVATED CARBONS

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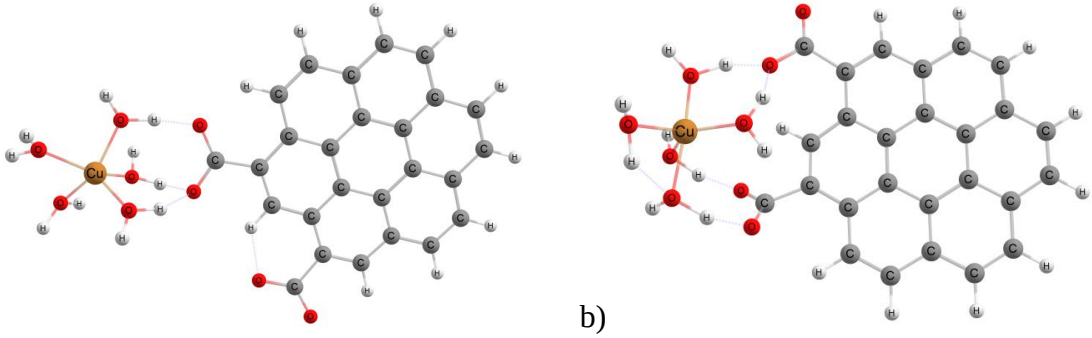
ABSTRACT

The presence of functional groups on the activated carbons plays an important role on their specific properties: acid-base character, catalytic properties, selective adsorption of metal ions etc. The present work aimed at the characterization of activated carbons surface chemistry (by using FTIR and XPS spectroscopy, and acid-base titration, pK_a of surface groups, pH_{pzc} etc.) and elucidation of metal ions binding mechanisms on the adsorbents by computational modelling (DFT B3LYP method using 6-31G(d) basis set; IEFPCM option of the Gaussian09 program package). In the study, activated carbons from walnut shells (CA-N) and apple wood (CA-M) modified with nitric acid (CA-Mox) and nitric acid/urea mixture (CA-Nox-u/CA-Mox-u), and samples modified with metals ions (Cu (II), Co (II) and Sr (II)) were used.

By acid-base titrations, on the oxidized carbonaceous adsorbents (CA-Mox, CA-Nox-u, CA-Mox-u) were identified four types of acidic functional groups with distinct pK. The XPS spectra, in addition to the bonds associated with the matrix of carbonaceous materials, bonds indicating the presence of oxygenated functional groups (C-C bond at 284.5 eV, C=C at 285 eV, C-OH and C-O-C structures at 286.6 eV, C=O and COOH at ~288.5 eV, O-C=O at ~290.5 eV) are identified, also due to the bonding between functional groups and metal ions. O 1s spectra show two main contributions associated to C=O bonds, at ~531.5 eV, and C-OH and C-O-C groups at ~533.2 eV. Computational modelling was applied to calculate the geometrical and electronic structures of all the studied systems and DFT calculations confirm the experimental results. In the case of copper ions, the hydrated ions are bound on the surface of oxidized activated carbons through carboxylic groups (depending on pH and pH_{pzc}) forming hydrogen bonds of the type O···H···O with one or two carboxylic groups (Figure 1).



a) b)

Fig. 1. Modeling the adsorption of $[Cu(H_2O)_5]^{2+}$ ions on the surface of activated carbon through carboxylic groups

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EVALUATION OF SCENARIOS FOR NUTRIENT RECOVERY FROM FOOD WASTE AND ESTIMATION OF ECONOMIC AND ENVIRONMENTAL EFFICIENCY USING COST-BENEFIT ANALYSIS

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ABSTRACT

Food waste refers to edible food discarded or left to degrade at various stages of the food supply chain, from production and processing to retail and consumption. Reducing food waste is crucial for sustainability and demands coordinated strategies across all sectors to minimize losses and enhance food utilization. Sustainable food waste management focuses on reducing the environmental, economic, and social impacts associated with discarded food. When food is wasted, resources used in its production—such as water, energy, and labor—are also lost, contributing to unnecessary carbon emissions, deforestation, and pollution. Sustainable practices aim to lessen this impact by reducing waste across all stages of the supply chain and by repurposing food innovatively, including recycling it into animal feed, bioenergy, or compost. By promoting responsible consumption, efficient supply chains, and waste reduction policies, these approaches protect ecosystems, reduce greenhouse gas emissions, and support food security.

Recovering nutrients from food waste is critical for environmental sustainability, economic efficiency, and food security, offering several key benefits: **(I) resource efficiency, (II) greenhouse gas reduction, (III) circular economy support, (IV) soil health improvement,** and **(V) economic value.** Nutrient recovery involves extracting valuable nutrients, such as nitrogen, phosphorus, and potassium, from organic waste to be reused as fertilizers or soil amendments. This process transforms food waste, which would otherwise contribute to landfill mass and greenhouse gas emissions, into a valuable resource for agriculture, reducing reliance on synthetic fertilizers.

The goal of this study was to evaluate the economic, social, and environmental impact of various nutrient recovery methods, including composting, anaerobic digestion, and other valorization technologies. Two processes were assessed: *(S1) nutrient recovery and bioproduct production through enzymatic hydrolysis to obtain starch from fruit, vegetable, and cereal waste;* and *(S2) nutrient recovery and biofuel production through enzymatic hydrolysis to obtain biohydrogen from rice, pasta, and fruit waste.*

The results indicate that starch recovery from food waste offers a highly efficient cost-benefit ratio, with significant economic advantages. This process proved very profitable. The biohydrogen production process is also profitable, although less so than starch recovery. In conclusion, the cost-benefit analysis demonstrates the economic viability of nutrient recovery processes, highlighting that starch recovery provides a particularly favorable cost-benefit balance, with benefits substantially outweighing costs.

Z(II), {ZN(II)AU(I)}, AND {ZN(II)AG(I)} COMPLEXES WITH SCHIFF BASE LIGANDS: PROMISING ANTITUMOR AGENTS AGAINST BREAST AND CERVICAL CANCER CELLS

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ABSTRACT

Malignant diseases are a major global health issue and the second leading cause of death worldwide. Chemotherapy remains one of the primary treatment options. However, its effectiveness is often limited by challenges such as high toxicity, multidrug resistance, and poor selectivity for cancer cells. These drawbacks highlight the need for innovative strategies and more effective chemotherapeutic agents.

As part of our ongoing research to develop new compounds with chemotherapeutic applications, we synthesized and characterized two families of homo- and heterometallic complexes, including $[Zn_2L^1(\mu\text{-}OH)(H_2O)_2](ClO_4)_2$, $[Zn_2L^2(\mu\text{-}OH)(H_2O)_2](ClO_4)_2$, $[Zn_2L^3(\mu\text{-}OH)(H_2O)_2](ClO_4)_2$, $^1_\infty[\{L^1Zn_2(\mu{-}OH)\}\{\mu{-}[Ag(CN)_2]\}](ClO_4)$, $[\{L^1Zn_2(\mu{-}OH)\}_2\{\mu{-}[Au(CN)_2]\}\{[Au(CN)_2]_2\}](ClO_4)\cdot H_2O$, $^1_\infty[\{L^2Zn_2(\mu_3{-}OH)\}_2(H_2O)\{\mu{-}[Ag(CN)_2]\}](ClO_4)_3\cdot THF\cdot 0.5MeOH$, $^1_\infty[\{L^2Zn_2(\mu_3{-}OH)\}_2(H_2O)\{\mu{-}[Au(CN)_2]\}](ClO_4)_3\cdot THF\cdot H_2O$, and $^1_\infty[\{L^3Zn_2(\mu{-}OH)\}\{\mu{-}[Ag(CN)_2]\}][Ag(CN)_2]\cdot H_2O$. Schiff base ligands for these complexes were prepared by condensing 2,6-diformyl-*p*-cresol with N,N-dimethyl-ethylenediamine (HL^1), 2-aminomethyl-pyridine (HL^2), and 2-aminoethyl-pyridine (HL^3).

The cytotoxic, cytostatic, and genotoxic effects of these complexes were assessed on cell cultures established from two of the most frequent and highly aggressive female malignancies: breast cancer (MCF-7 (luminal type A) and MDA-MB-231 (triple negative breast cancer)) and cervical cancer (HeLa), and on non-tumor embryonal fibroblastoid cells (Lep-3). These evaluations were conducted through a range of assays: the MTT test, neutral red uptake assay, crystal violet staining, hematoxylin and eosin staining, double staining with acridine orange and propidium iodide, Annexin V/FITC assay, and Comet assay in short-term studies (24-72 h, in monolayer cell cultures), as well as through the 3D colony-forming method in long-term studies (28 days, with 3D cancer cell colonies). It was demonstrated that within a 0.1–100 µg/mL concentration range, these complexes reduce cell viability and proliferation in a time – and concentration-dependent manner; {Zn(II)Au(I)} complexes exhibit relatively higher cytotoxic and genotoxic activity compared to {Zn(II)Ag(I)}; all tested complexes demonstrated strong cytotoxic and antitumor

effects, with some surpassing the standard antitumor agents cisplatin, oxaliplatin, and epirubicin. Notably, these complexes showed significant activity against triple-negative breast cancer cells, a cancer subtype that remains challenging to treat in clinical oncology.

Acknowledgements: This study was conducted in the frame of a joint research project between Romanian Academy and Bulgarian Academy of Sciences entitled „*Cancer therapy: searching for new potential drugs*".

EFFECT OF GLUCOSE, NACL AND UREA ON THE INTERACTION OF QUINIZARIN WITH SDS MICELLES

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ABSTRACT

Quinizarin (1,4-dihydroxy-9,10-anthraquinone) is a synthetic anthraquinone with different uses: fungicide and pesticide, antioxidant, dye and additive in lubricants to check oxidation and corrosion in engines. [1,2] From pharmaceutical point of view, quinizarin molecule contains the planar anthraquinone unit typical of some biologically and pharmaceutically significant compounds, including several antitumor drugs such as doxorubicin, daunorubicin and mitoxantrone which are widely used in clinical practice. Due to their structure (aggregates with a hydrophobic core and a hydrophilic shell), SDS micelles mimic the native lipid bilayer environment and are used to study the interactions of different drugs with membranes. [3,4] Sodium ions, glucose and urea are present in blood plasma in variable quantities and their presence may influence the drug biological activity. Hence, it is important to get knowledge of drug–micelle association behavior in the presence of different physiological additives.

The current paper presents the results regarding the influence of glucose, NaCl and urea on the interaction of quinizarin with SDS micelles. [5] The studies were carried out using absorption and electrical conductance measurements.

The spectral results show that the binding constants and partition coefficients increase in the presence of glucose and NaCl whereas the addition of urea leads to a decrease of binding strength and quinizarin partitioning into SDS micelles. Thus, the higher NaCl and glucose concentrations are favorable for the quinizarin distribution into SDS micelles. From electrical conductivity measurements it was found that the critical micelle concentration (CMC) of SDS/quinizarin system decreases by adding NaCl and glucose whereas urea has not influence on the micelization process at the concentrations used in the present study. [5]

These results may provide valuable information in seeking better drug formulation and drug delivery systems taking into account that glucose, NaCl and urea are compounds found in body fluids.

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MATERIALS WITH APPLICATIONS IN DYES DEGRADATION

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ABSTRACT

Dyes are colored aromatic chemical compounds that absorb light and impart color to the Vis region. Textiles, rubber, cosmetics, food, medicine, and the paper industry are just a few of the industries that use different dyes for various purposes. These enterprises produce massive amounts of wastewater contaminated with toxic and carcinogenic dyes. Methylene blue (MB) is a non-biodegradable compound that can cause negative effects on the environment and pose a major risk to human health. MB poses several risks to human health such as blindness, respiratory distress, digestive disorder, and mental illness [1].

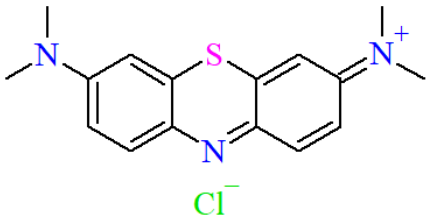

Figure 1. The structural formula of methylene blue

Advanced oxidation processes are based on the in situ generation of oxygen reactive species, such as hydroxyl radicals or superoxide anion radicals, that completely oxidize organic pollutants. These processes have been recognized as a potentially effective water treatment technique, particularly for those refractory pollutants. The most popular and cost-effective technique for removing contaminants from wastewater is photocatalysis mediated by nanomaterials [2,3].

This study focuses on the synthesis and characterization of TiO_2 nanoparticles, but also on testing the photocatalytic activity using a solution of methylene blue. The syntheses were made by sol-gel method and 2 titanium precursors were used: titanium isopropoxide and titanium(triethanolaminato)isopropoxide. TiO_2 was calcined at 2 different temperatures, 550°C and 700°C to verify the influence of calcination temperature on the photocatalytic properties of the materials.

FT-IR technique was used to obtain infrared spectra of the TiO_2 nanoparticles, confirming that the synthesis was successful.

TG-DSC technique was used to analyze the thermal properties of the TiO_2 nanoparticles, after the photocatalytic degradation of methylene blue has been carried out.

SEM analysis was performed to investigate the effect of calcination temperature on the morphology and particle size of the TiO_2 nanoparticles.

The photocatalytic activity of the TiO_2 nanoparticles was tested on a solution of methylene blue with a concentration of 10 ppm, under UV light irradiation for 3 hours.

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COBALT ALUMINATE NANOPARTICLES OBTAINED THROUGH A SOFT CHEMISTRY ROUTE USING MENTHA LEAVES EXTRACT

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ABSTRACT

The industrial development and the expansion of the concept of comfort generated an unprecedented degree of environmental pollution. Consequently, the scientific world has turned its attention to obtaining nanomaterials that help to the environment depollution. Moreover, the development of green synthesis methods to obtain these materials has captured the interest of researchers. Various natural resources, including certain plants, are being studied for their efficacy as potent chelating/capping/reducing agents in nanoparticle synthesis [1]. In the field of nanomaterials, the environmentally sustainable synthesis of spinel aluminates represents a notable achievement, providing both ecological sustainability and diverse application possibilities. A notable member of these materials is cobalt aluminate ($CoAl_2O_4$). Because of its unique properties, it is widely used for various applications. As photocatalyst, $CoAl_2O_4$ is used for the degradation of methyl orange and Congo red dye [2,3].

The present study proposes an efficient and green approach of solution combustion method to obtain $CoAl_2O_4$ photocatalyst, using a *Mentha piperita* leaves extract as fuel (reducing agent). The obtained aluminate was analyzed in terms of structure, morphology and surface chemistry by various techniques such as: XRD, SEM and TEM, XPS, FT-IR, Raman, and UV–Vis spectroscopy. The results confirmed the formation of a single-phase, $CoAl_2O_4$ spinel with rhombic and rectangular particles and unimodal particle size distribution. The photocatalytic activity of the as-synthesized nanomaterial was evaluated for methylene blue (MB) photodegradation. Based on the photocatalytic results, $CoAl_2O_4$ prepared through mentha-mediated strategy could be considered as active materials for degradation of organic compounds (dyes, phenol) from waste waters.

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EXPLORING THE ANTIBACTERIAL ACTIVITY OF MIXED-LIGAND COPPER(II) COORDINATION COMPOUNDS WITH N-(4-METHOXYPHENYL)-2-OXOPROPANAMIDE 4-ALLYLTHIOSEMICARBAZONE

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ABSTRACT

New antimicrobial agents are required to provide better modes of action, and there is also a need to identify new pharmacological targets. This is essential to prevent the reliance on broad-spectrum antibiotics and to combat the rise of antibiotic resistance. Pyruvic acid is a natural compound that possesses antibacterial properties, demonstrating potential for use in combating bacterial infections. Thiosemicarbazones and their derivatives have been identified as effective antimicrobial agents against pathogenic bacteria and fungi that affect humans. Therefore, the aim of this work is to study the pyruvic acid amides thiosemicarbazones and their mixed ligand copper(II) complexes, focusing on the results obtained from combining natural and chemical substances as potential antibacterial agents.

The synthesis of *N*-(4-methoxyphenyl)-2-oxopropanamide 4-allylthiosemicarbazone (HL) was carried out in two stages. First, *N*-(4-methoxyphenyl)-2-oxopropanamide was synthesized by reacting pyruvic acid, oxalyl chloride, and para-anisidine in CH_2Cl_2. The second stage involves the reaction of 4-allyl-thiosemicarbazide and *N*-(4-methoxyphenyl)-2-oxopropanamide in hot ethanol solution, in 1:1 molar ratio. The obtained *N*-(4-methoxyphenyl)-2-oxopropanamide 4-allylthiosemicarbazone was studied by NMR and FT-IR spectroscopy. To obtain mixed-ligand copper(II) coordination compounds, complex $[Cu(L)NO_3]$ was first prepared by interaction between HL and copper(II) nitrate trihydrate in ethanol. Then, the resulting complex was dissolved in ethanol, and the corresponding *N*-heteroaromatic base was added. As a result, seven mixed-ligand copper(II) complexes were obtained: $[Cu(1,10\text{-Phen})(L)]NO_3$, $[Cu(2,2'\text{-BPy})(L)]NO_3$, $[Cu(3,4\text{-Lut})(L)]NO_3$, $[Cu(4\text{-Pic})(L)]NO_3$, $[Cu(3\text{-Pic})(L)]NO_3$, $[Cu(Py)(L)]NO_3$, $[Cu(Im)(L)]NO_3$. All complexes were studied using FT-IR spectroscopy, elemental analysis and molar conductivity.

Antibacterial activity against gram-positive microorganisms *Staphylococcus aureus* (ATCC 25923) and *Bacillus cereus* (ATCC 11778) was studied for all synthesized substances. 4-Allylthiosemicarbazone is active only against *Bacillus cereus*. Its coordination to the copper(II) atom in the complex $[Cu(L)NO_3]$ leads to a significant increase in activity against both microorganisms. In most cases, the introduction of *N*-heteroaromatic bases into the inner sphere of the copper(II) nitrate complex did not lead to an increase in the activity of the resulting complexes. An increase in activity is observed only in the case of the complex $[Cu(Im)(L)]NO_3$. This complex shows greater activity than both the copper(II) nitrate complex and 16 times higher than *N*-(4-methoxyphenyl)-2-oxopropanamide 4-allylthiosemicarbazone against *Bacillus cereus*.

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A BIOACTIVE TETRAAZA MACROCYCLIC COMPLEX OF CO(III) TARGETS THE M2 PARALLEL G-QUADRUPLEX DNA STRUCTURE: CD SPECTROSCOPIC STUDIES

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ABSTRACT

In recent days the structural motif of G-quadruplexes (G4) DNA is well-recognized by its major implications in some crucial functions of human genome and transcriptome [1]. Particularly, development of some G4-associated human deseases, such as cancer and neurological maladies was found directly related to the presence of G4s in both DNA and RNA [2].

The budding yeast *Saccharomyces cerevisiae* has been known as an excellent microbial cell factory for producing valuable recombinant proteins and one of the strategies that enhance protein production is based on regulating transcription through promoter engineering [3]. Recent genome-wide sequencing studies have uncovered that DNA of *Saccharomyces cerevisiae* contains a significant number of sequences capable of forming G4s – approximately 700. These sequences are not randomly distributed; instead, their locations tend to align with functionally critical genomic areas, including gene promoters [4].

In continuation of the recently reported synthesis, NMR characterisation, crystal structure, antimicrobial properties and duplex DNA studies for the macrocyclic Co(III) complex obtained by template synthesis [5] (Figure 1, a), we present now the results of investigating its biological effects on an autochthonouss *Saccharomyces cerevisiae* CNMN-Y-20 strain, isolated from wine waste sediments [6], as well as circular dichroism (CD) studies aimed at elucidating its ability to interact with G4 DNA of parallel topology.

The influence of $CoHCl_2$ complex (**1**), at a concentration of 5; 10; 15; 20 mg/L of nutrient medium, respectively, has been estimated on biomass productivity, carbohydrate synthesis, protein production and antioxidant activity of *S. cerevisiae* CNMN-Y-20 strain. The bioactivity assays have demonstrated that complex **1** in the concentrations of 5 and 10 mg/L slightly increases the biomass productivity of the strain, while significantly stimulates protein synthesis, by cca 30% and practically does not influence the content of carbohydrates, inhibiting the total antioxidant activity of the studied strain biomass. Increasing the concentration of the complex **1** in the cultivation medium up to 15-20 mg/L negatively influenced all the parameters studied, which indicated a certain degree of toxicity of the tested compound.

Investigation of the compound **1** induced conformational changes within M2 G4 DNA[7] by CD spectroscopy studies has proved that Co(III) complex induces strong stabilization of the G4 structure. The M2 G4 sequence (5'-TTG GGA TTG GGA TTG GGA TTG GGA TT- 3') exists in a parallel-stranded conformation, as indicated by a major positive band at 265 nm and a negative band at 243 nm (Figure 1, b) [8]. Upon addition of $CoHCl_2$ (**1**), a dose-dependent increase in the intensity of both bands was observed, with no other significant changes in the shape of the spectrum. This effect has also been observed for other effective G4 ligands [9], pointing at the ability of Co(III) ligand to produse stabilizing effects on the investigated parallel G4 DNA structure, without changing the overall sequence initial conformation.

The currently reported proofs offered by using CD spectroscopy, with respect to the targeting G4 DNA of parallel topology over the duplex DNA[5], may serve as one of the plausible explanations for the observed satisfactory increase in protein production by the *Saccharomyces cerevisiae* CNMN-Y-20 strain.

The obtained results may serve as starting point for further structural insight of the interaction between the complex **1** and M2 G4 DNA of parallel topology, in order to clarify the individual details of this binding. This investigation may be helpful for future design of optimized analogues of complex **1**, as deepening the knowledge about the non-canonical G4 DNA structures may deliver significant tools through which the secretory pathway of *Saccharomyces cerevisiae* CNMN-Y-20 strain can be engineered to ensure more efficient protein production.

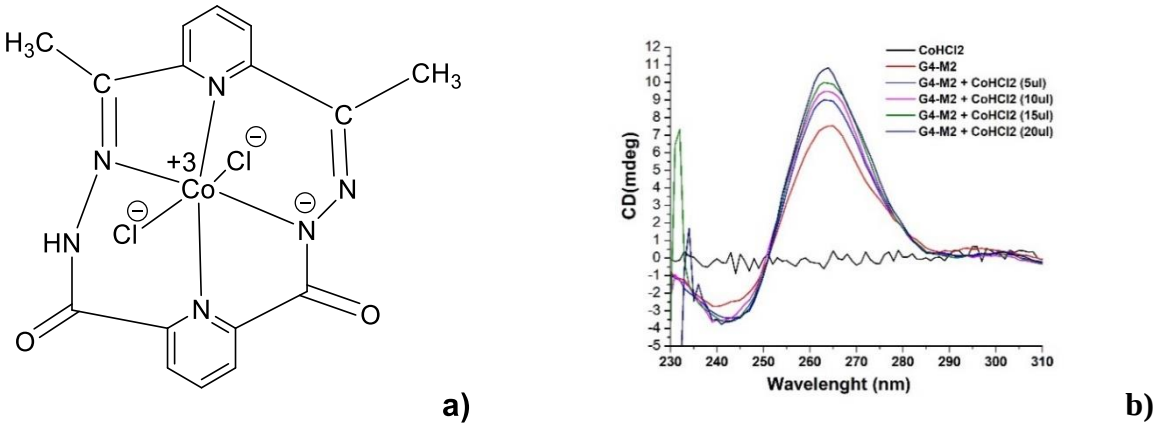

Figure 1. Bioactive macrocyclic Co(III) complex **1**: a) chemical structure; b) CD titration spectra of M2 G4 DNA with varying amounts of $CoHCl_2$ **1** in 100 mM KPi (pH 7.4) and KCl.

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EVALUATION OF *HALOXYLON SCOPARIUM* EXTRACT AS A GREEN ANTIOXIDANT AND CORROSION INHIBITOR FOR ORDINARY STEEL IN 1M HCl MEDIUM

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ABSTRACT

Plant extracts, rich in bioactive compounds such as polyphenols and saponins, are increasingly used as eco-friendly and renewable alternatives to synthetic corrosion inhibitors. Their effectiveness against metal corrosion makes them promising for industrial applications, as supported by encouraging research outcomes.

This study focuses on the valorization of *Haloxylon scoparium*, a plant native to southeastern Morocco, as an antioxidant and corrosion inhibitor. The roots were extracted through maceration using a water/acetone mixture, followed by liquid-liquid extraction with butanol. Antioxidant activity was evaluated using the DPPH free radical reduction test and Ferric Reducing Antioxidant Power (FRAP) assay, while anticorrosion properties were analyzed using electrochemical impedance spectroscopy and potentiodynamic polarization.

The extract demontrated a yield of 50.35 mg/g MS and significant antioxidant activity, with inhibition concentrations (IC50) of 0.066 ± 0.003 mg/mL and 0.190 ± 0.070 mg/mL in the DPPH and FRAP tests, respectively, which are comparable to ascorbic acid (0.082 ± 0.013 mg/mL and 0.100 ± 0.007 mg/mL). Tafel plots revealed that the extract acts as an effective mixed inhibitor with a predominance of anodic inhibition, achieving a maximum inhibition efficiency of 94.2 % at a concentration of 0.5 g/L and a temperature of 298 K. Impedance spectroscopy indicated a single capacitive loop, associated with the charge transfer process, while adsorption of the inhibitor on the metal surface formed a protective film, effectively reducing ordinary steel corrosion.

Temperature-dependent studies showed a slight reduction in inhibition efficiency with increasing temperature. The mixed adsorption of the extract follows the Langmuir isotherm, and thermodynamic parameters indicate that the extract predominantly adsorbs physically onto the metal surface.

In conclusion, this study clearly demonstrates the potential of *Haloxylon scoparium* extract as an efficient, eco-friendly corrosion inhibitor for ordinary steel in acidic environments, while also exhibiting notable antioxidant properties.

SENSITIVE DETECTION OF ETHANOL IN AQUEOUS SOLUTIONS USING A PLASMONIC SENSOR

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ABSTRACT

Ethanol is widely used in a variety of industries, including the food, beverage, and pharmaceutical sectors. It is transparent, combustible, and rapidly evaporates. As a result, trustworthy and accurate ethanol sensors are urgently needed in the aforementioned industries to maintain acceptable alcohol levels [1]. Ethanol content is typically measured using diverse techniques based on densitometry, spectrophotometry, colorimetry, liquid chromatography, mass spectroscopy, electrochemistry methods, etc. Nevertheless, these methods have limitations in terms of response time, costs and feasibility for continuous monitoring [2]. Fibre optic plasmonic sensors offer advantages over conventional techniques, including high precision, low complexity, small size, and resistance to electromagnetic interference [3].

In this research, a reflection-based fiber optic-surface plasmon resonance (FO-SPR) sensor for accurate ethanol detection in water and beer solutions was developed. The FO-SPR sensing performance was examined by analyzing the change in wavelength shift observed by varying ethanol concentration in both liquids (water and beer) from 0 to 99.9 %.

The obtained results are promising and are important for the food and pharmaceutical industries to protect human health from the harmful effects due to the high ethanol concentration.

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SYNTHESIS AND IN VITRO EVALUATION OF BIOACTIVE COMPOSITES FOR BONE TISSUE ENGINEERING

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ABSTRACT

Traumatic bone defects, degenerative diseases or surgical excision of tumors result in an absence of tissue, which requires bone addition [1]. Currently, autografts are the main treatment route, due to their high histocompatibility, osteogenicity and osteoinductivity, but have certain disadvantages, as infection, donor site morbidity and chronic pain [1]. In recent decades, new advanced supports with interconnected porosity have been developed through regenerative medicine, which have the potential to incorporate the patient's own cells and bioactive molecules (growth factors or drugs), with the aim of achieving a personalized therapeutic approach for tissue regeneration [2]. Regarding bioactive principles, statins are suitable for bone regeneration application, due to their ability to induce osteogenic and angiogenic factors [3].

Characterized by good osteoinductive and osteoconductive properties, calcium phosphates has been remarked for superior biological properties, but the clinical applicability of these biomaterials has been limited due to their fragility and low mechanical strength. A promising approach to modulate the properties of bone scaffolds has been investigated by using natural or synthetic polymers origin in various combinations, thus improving mechanical properties, processability and bioactivity [4].

Taking into account the key aspects listed, the aim of the present study was to obtain composites based on two polysaccharide (N-succinyl chitosan and sodium alginate), respectively a constituent of bone tissue (nanohydroxyapatite). The obtained bone scaffolds were evaluated *in vitro* regarding the chemical composition and morphology through specific characterization techniques. Also, the obtained scaffolds were tested regarding the *in vitro* interaction with simulated body fluids, from the point of view of the behaviour under simulated biomechanical stresses, respectively regarding the behaviour in enzymatic environments in order to provide relevant information about their biodegradability capacity. Another objective was to incorporate bioactive molecules (statins) in the structure of the scaffolds and determine the *in vitro* release kinetics of the active principles. Following *in vitro* tests, the obtained scaffolds demonstrated biodegradability and moderate degrees of swelling. Young modulus proved to be composition dependent, and the values obtained are comparable to those of porous hydroxyapatite bioceramics.

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SUSTAINABLE FABRICATION OF ZINC OXIDE NANOPARTICLES INCORPORATED INTO SODIUM ALGINATE BEADS FOR CONTROLLED-RELEASE BIOFERTILIZERS

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ABSTRACT

The study employed an eco-friendly approach to synthesize zinc oxide nanoparticles (ZnO-NPs) using an extract from Citrus limon leaves, leveraging the plant's natural bioactive compounds as reducing and stabilizing agents. These ZnO-NPs were integrated into sodium alginate beads, which served as a carrier matrix encapsulating the commercial fertilizer Urea 46%. Structural and morphological characterization through X-ray diffraction (XRD) confirmed the crystalline nature of the ZnO-NPs, while scanning electron microscopy (SEM) revealed the successful incorporation of the nanoparticles into the alginate matrix.

The resulting nanocomposite beads exhibited a steady and controlled release of urea over a one-hour period, demonstrating their potential for efficient nutrient delivery. This work highlights the synergy between ZnO nanoparticles, which offer antimicrobial and nutrient-enhancing properties, and sodium alginate, known for its biocompatibility and gel-forming capabilities, to create an innovative platform for slow-release biofertilizers. This approach promotes sustainability by combining eco-friendly synthesis with effective agricultural practices.

Keywords: biosynthesis; ZnO-NPs; Alginate bead, fertilizers; Urea; encapsulation; release.

IRON-CONTAINING CATALYSTS OBTAINED BY SOL-GEL COMBUSTION SYNTHESIS FOR CO_2 HYDROGENATION

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ABSTRACT

Carbon dioxide is using as a raw material for obtaining useful products, such as methane, olefins, gasoline, aromatics and alcohols, etc. [1]. Catalytic hydrogenation of CO_2 to obtain olefins effectively occurs on Fe-containing catalysts [2]. In this work Fe-containing catalyst was synthesised by sol-gel combustion. Phase composition, chemical state of iron and catalytic properties in the CO_2 hydrogenation were studied.

Catalyst Fe-CN/PAA was prepared according to the following method. Reducing fuel (hexamethylenetetramine) was added to iron nitrate solution and mixed with cross-linked polymer (PAA) of sodium acrylate and acrylamide to formation of homogeneous gel-like mass. Then it was dried at 100°C until xerogel was formed. The xerogel in quartz tube was sent to tubular furnace preheated to a temperature of 600°C, where exothermic reaction occurred in argon atmosphere upon reaching the initiation temperature.

According to XRD data, sample Fe-CN/PAA contains the phases of Fe_3N, Fe_3O_4, FeO, Fe_5C_2, Fe_2C and Fe_3C. It is known that carbides Fe_5C_2 and Fe_2C are active phases in hydrogenation of CO_2 to long-chain olefins. Results of TEM shows that some particles of Fe-CN/PAA are covered with carbon shell. Data of XPS shows that surface content of Fe is low (1-2 wt.%) that indicates high share of particles covered with carbon shell. According to magnetometry results temperature dependent magnetization curve has inflections at temperatures of 230 °C and 390 °C, which corresponds to the Curie temperatures of iron carbides (210 °C for cementite Fe_3C, 250 °C for χ-carbide Fe_5C_2 and 380 °C for ε-carbide Fe_2C). TPR profile of Fe-CN/PAA contains two peaks with maximum at 445 °C and 530 °C, which may correspond to the transitions $Fe_3O_4 \rightarrow FeO$ and $FeO \rightarrow Fe$. According to DRIFTS of CO_2 data, catalyst Fe-CN/PAA contains active particles capable of CO2 adsorbing, which can participate in CO_2 hydrogenation [3].

The catalyst was tested in CO_2 hydrogenation at pressure of 30 atmospheres and temperature range from 280 to 360 °C. Mass of catalyst is 500 mg, CO_2 flow is 8 ml/min, H_2 flow is 24 ml/min, catalyst was pre-activated in hydrogen flow of 30 ml/min at temperature of 400 °C for 8 h. Conversion of CO_2 increased from 8% to 23% with increasing of temperature, the main product is CO (about 40-60%). Selectivity of CH_4 decreased from 95% to 74% with increasing of temperature. Ratio of olefins/alkanes is 0,2-6,7 depending on hydrocarbons.

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DECORATIVE TILES

SYMBOLISM, TECHNICAL, AND CHROMATIC PROBLEMS

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ABSTRACT

Art is a cultural act, and the creation is, at the same time, a mystery and a revelation of the world that leads to scientific discoveries and inventions. The archetypal symbols recognized as the first forms of communication, placed inside and outside of the house, arranged in isolation or interspersed with points, lines and concentric circles or spiral double, triple, or complex, which takes first place – it sustains the infinitely cosmic movement, unites the opposite poles of existence (birth and death) and is the leitmotif of the repeated rhythms of life, dependent on the fundamental elements: air, water, fire and clay [1,2].

From the decorative tiles, clay is easily molded due to the plasticity index: Ip > 30% for superior clays, Ip = 15–30% for medium clays, Ip = 7–15% for plasticity low and Ip < 7% for the non-plastic clays. The decoration can be *sculpted* or *polychrome*, made totally or partially, by immersing in a paste with varied content of oxides, what colors engobes (I) and ceramic glazes (II) [3].

The combinations between PbO, Na_2O, CaO, MgO, BaO, Li_2O, SrO, Sb_2O_3, ZnO, Al_2O_3, Fe_2O_3, SiO_2 give uniform colors in the oxidizing atmosphere; above 8–12% precipitation effects appear in the form of crystals, and above 25% the colors become matte, brown and dark. For example, Na_2O and B_2O_3 give a bluish tint, CaO discolors, TiO_2 leads to ocher and smoky shades, ZnO and ZrO_2 clouds the color, and BaO matifies to yellow. By reducing the atmosphere, the Fe_2O_3 is transformed in the presence of CO_2, and the result is a black pottery with closed pores that does not require additional combustion [4].

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ACOUSTIC AND OPTICAL ANALYSIS OF POLYVINYLPYRROLIDONE-K60 IN ETHANOL/WATER BINARY MIXTURES. APPLICATIONS IN THE SYNTHESIS OF NANOPARTICLES

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ABSTRACT

Acoustical and optical studies of polymeric mixed solutions in different solvents have drawn the attention of many researchers [1-3].

In the present investigations, the experimental data of densities, refractive indices, and speeds of sound, for the binary mixtures of Polyvinylpyrrolidone-K60 in Ethanol, and in Water solvents have been measured as a function of polymer concentration between (0 and 0.00081) mol kg^{-1} at temperatures of (298.15, 308.15, and 318.15) K.

The reaction media frequent used in different nanoparticles syntheses are water, ethanol, and aqueous ethanol mixture [4,5].

More than that, the Polyvinylpyrrolidone (PVP) polymer is used as a stabilizer for the preparation of various nanoparticles (rhodium, gold, s.a.) as new approaches to synthesize different sizes and shapes of nanoparticles in a single step, in function of increasing the polarity of solvents [4].

The thermophysical parameters such as the acoustic impedance, specific refraction, relaxation strength, isentropic compressibility, and space-filling factor, have been computed over the entire polymer composition range based on the experimental values. The results are discussed in terms of molecular interactions and structural changes specific of PVP-K60+EA/H_2O in studied mixtures.

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STUDY OF ANTICORROSIVE PROPERTIES OF THIN FILMS IN ACID MEDIA

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ABSTRACT

In this work we studied the obtaining of thin films deposited by deep-coating or e-gun technology . The aim of the research was to create thin films with an anti-corrosive surface in acidic environments. The studied films have zinc oxide in their composition. The morphology and roughness of the films were evaluated by profilometry. Hydrophobic properties of thin films increased with amount of zinc oxide in composition and the roughness has a great influence on it. All thin films have a transmittance greater than 65% in the visible region and are transparent in the infrared. The contact angle was measured for all thin films and the hydrophobic or hydrophilic properties of the surface were determined. After corrosion in acidic media the surface has different responses depending on the chemical composition. In the case of hydrophobic films, the property is maintained or lost. The surface of the films before and after the acid attack was investigated. Structural characterization was performed by X-ray diffraction (XRD) and infrared spectroscopy (FTIR). The thin films studied showed anticorrosive properties that give them the possibility to be used for sensors or solar cells.

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THE ROLE OF THE POLYPHENOLS IN DEVELOPING COATED STENTS

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ABSTRACT

CardioVascular Diseases (CVD) are known to be a class of diseases which are annually generating the highest number of deaths. In this context, the use of stents is increasing but some problems haven't yet solved and this is why new solutions are needed. The evolution of the stents knows several steps, from bar metal stents (mostly stainless steel, Co-Cr alloy, Ti and NiTi-ol to resorbable stents (polymers stents such as polylactic based stents or Mg alloys) some of these stents being able to release specific drugs (such as PLA-paclitaxel based stents), etc. Some of the most recent stents are functional coated stents, the coatings being realised using complexes based on polyphenols and copper, the mostly used polyphenols being epigallocatechin 3-gallate (EGCG), gallic acid, curcumin, these polyphenols being not only efficient in developing a hydrophilic and antiadherent surface but also being able to generate nitric oxide, a specific vasodilator agent produced by the human and animal body [1]. In this work, the preliminary results are presented related to the complex formation and characterisation.

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THE USE OF NANOPARTICLES IN TARGETING CANCER CELLS AND REDUCING THE SIDE EFFECTS OF CHEMOTHERAPY

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ABSTRACT

Nanoparticles, such as liposomes, polymeric, and their applications in chemical engineering, as well as the use of metal oxide-based nanoparticles in transporting drugs directly to target cells, increase efficiency and reduce side effects. Nanoparticles are being investigated for their role in cancer immunotherapy, helping to stimulate the immune response by delivering antigens or adjuvants;

In recent years, interest in nanotechnology has grown exponentially due to increased technological progress and innovation. In tissue engineering, the development of metal nanoparticles or metal oxides has been boosted, especially due to their antibacterial and therapeutic properties. Nanoparticles have become promising tools for targeting cancer cells due to their unique properties, such as nanoscale size, functional surface, and the ability to interact with cells at the molecular level.

The identification of criteria for nanoparticle selection led to the distinction of several types of metal nanoparticles used to target cancer cells and how they can be optimized for anti-cancer treatments.

In parallel, treatments of natural origin (adding molecules) such as curcumin, quercetin, including the use of essential oils, have attracted increased interest. In vitro studies have demonstrated their cytotoxic effects on cancer cells, the main mechanism being the initiation of apoptosis.

The main aim of this study is to determine the research branch of the PhD thesis and to identify new anti-cancer therapies, by using both chemical and natural compounds, along with various types of transport systems based on metal nanoparticles.

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SYNTHESIS AND SPECTRAL CHARACTERIZATION OF N-(4,6-DIMETHYLPYRIMIDIN-2-YL)-2-[1-(PYRIDIN-2-YL)ETHYLIDENE]HYDRAZINE-1-CARBOTHIOAMIDE

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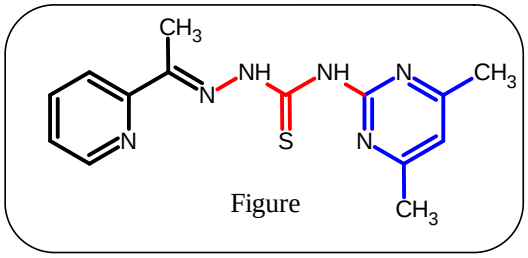
ABSTRACT

Thiosemicarbazones are organo-sulfur compounds with the general formula RRNC(S)NHN=CRR, representing numerous variations, including those in which some or all of the hydrogen atoms of the amino groups are substituted with organic groups. A key characteristic of them is their chelating ability due to the presence of sulfur and nitrogen atoms, which allows them to form complexes with metal ions [1]. This class of compounds possesses a wide spectrum of medicinal properties and is intensively studied for their antimicrobial, antiviral, and antifungal activities [1, 2]. In recent decades, thiosemicarbazones derived from 2-acetylpyridine and 2-formylpyridine [2] as well as other related carbonyl components have shown particular interest due to their enhanced bioactivities. Due to these activities, thiosemicarbazones have been clinically tested for a variety of conditions, such as tuberculosis, viral infections, malaria, cancer, etc.

Thiosemicarbazones, which are made from pyrimidines, are a promising group of organic compounds that combine the best features of two basic structures. The pyrimidine ring is found in DNA's nitrogen bases (cytosine, thymine, and uracil) and in many bioactive molecules, such as barbiturates, fungicides from the anilinepyrimidine class, and herbicides from the sulfonylurea class. This means that these chemicals may be able to attach to biological systems. The thiosemicarbazide group, on the other hand, can form chelates with transition metals. This increases the range of biological activities that are possible and makes it easier for new substances with therapeutic potential to come about.



Figure

Synthesis of N-(4,6-dimethylpyrimidin-2-yl)-2-[1-(pyridin-2-yl)ethylidene]hydrazine-1-carbothioamide (Figure), was used as starting substance: 2-amine-4,6-dimethyl-pyrimidine. By using classical methods of synthesis, we obtained the intermediate 2-isothiocyanato-4,6-dimethylpyrimidine from this amine. We used thiophosgene as a thiocarbonylation agent to prepare this isothiocyanate. Then by nucleophilic addition of hydrazine to the obtained isothiocyanate, N-(4,6-dimethylpyrimidin-2-yl)hydrazinecarbothioamide was synthesized. We then condensed the obtained thiosemicarbazide with 2-acetylpyridine in an alcoholic medium, acidified with acetic acid, to yield the final product. The structure of the compound was confirmed by FTIR, NMR, and elemental analysis.

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ANTIMICROBIAL PACKAGING FILMS BASED ON CELLULOSE WITH FOOD ADDITIVES

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ABSTRACT

Cellulose derivatives are gaining much attention in food industry as well as biomedical research due to their excellent properties such as biocompatibility, non-toxicity, sustainability, hydrophilicity and low cost. Unfortunately, cellulose does not exhibit antimicrobial activity. However, derivatives like hydroxyethyl cellulose represent a proper matrix to incorporate antimicrobial agents with beneficial therapeutic effects. **Methods**: Combining more antimicrobial agents into a single composite material can induce stronger antibacterial activity by synergism. **Results**: Therefore, we have obtained a hydroxyethyl-cellulose-based material loaded with zinc oxide nanoparticles and cinnamon essential oil as the antimicrobial agents [1]. The cinnamon essential oil was loaded in mesoporous silica particles to control its release [2]. **Conclusions**: The composite films demonstrated high antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* strains, impairing the bacterial cells' viability and biofilm development. Such antimicrobial films can be used in various biomedical applications such as packaging for the food industry or as topical dressings.

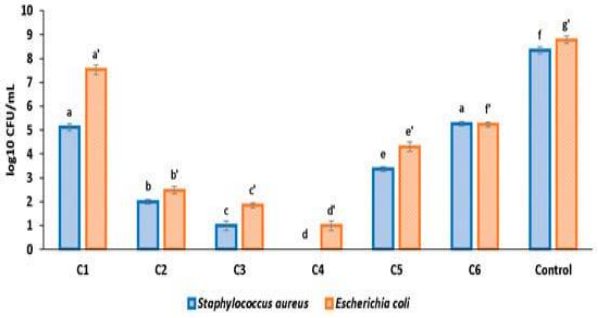

Figure1. Biofilm development at 24 h for C1–C4 samples; HEC-ZnO (C5) and HEC-MCM-41@CEO (C6) used for comparison; different small letters indicate statistically significant differences between films ($p < 0.05$) for each strain (a–f for *S. aureus* and a'–g' for *E. coli*).

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NEW INSIGHTS INTO THE CYTOTOXICITY AND BIOCOMPATIBILITY OF THREE TYPES OF ENDODONTIC MATERIALS –A COMPARATIVE PILOT STUDY

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ABSTRACT

Assessing the biocompatibility of endodontic root-end filling materials through cell line G-292 human osteoblasts responses is both essential and of utmost importance. This study aimed to explore the cytotoxicity, and the biocompatibility of cells incubated for 24 hours & 48 hours with the following types of endodontic materials: Ketac Molar EasyMix (glass ionomer cement), AH Plus (epoxy resin sealer), GuttaFlow 2 (silicone-based sealer).

The cell line (G-292) is represented by osteosarcoma cells. The material samples have been obtained according to the manufacturer's technical specifications. The following assays were performed: for cell viability – MTT ((3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide)); for cytotoxicity – Griess Test (NO – Nitric Oxide) and LDH (Lactate Dehydrogenase).

Our results revealed that:

– in the case of GuttaFlow 2 we did not notice significant differences in terms of the viability test (MTT) for both incubation times, compared to the control, but regarding the Griess test, after 48 hours the NO level increased by 20% vs. control.

– regarding AH Plus, viability was significantly reduced, 92% and 88% for 24 and 48 hours respectively; correlated with these results, LDH levels increased approximately 4 times at 24 hours and 3 times after 48 hours compared to the control; the Griess test revealed an increment by 47% and 49% of NO level after 24 and 48 hours, respectively, compared to the control.

– concerning Ketac Molar, according to the MTT test, the viability was reduced by approximately 30% compared to the control; the results of the Griess test showed an increase of 18% and 27% for 24 and 48 hours, respectively, vs control.

As far as we know, there are few studies that compare the biocompatibility of these three classes of endodontic materials. Our results have illustrated that the best biocompatibility was demonstrated by the material belonging to the category of silicone-based sealers, GuttaFlow 2. Our results may offer valuable insights into the biocompatibility of glass ionomer cements, epoxy resin sealers and silicone-based sealers.

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FUNCTIONALIZED HYDROXYAPATITE COATINGS BY MAPLE: A NOVEL APPROACH IN BONE TISSUE ENGINEERING

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ABSTRACT

Bone tissue engineering has seen remarkable advancements in recent years in accordance with the medical necessity for the proper treatment of numerous bone defects or osseous diseases. These developments involve multiple areas, including innovative material synthesis methods, novel application techniques, and innovative cell engineering approaches. To address this issue and improve the quality of life after implantation, researchers in the proposed the potential to combine biomaterials and tissue engineering applications. While the ideal material for mimicking natural bone regeneration has not yet been developed, multifunctional nanomaterials with enhanced biological properties have gained significant attention in biomedicine. The latest research has shown that the synthesis of functionalized biomaterials with complex structures from natural sources (such as fish bones, seashells, or eggshells) is an effective strategy for obtaining hydroxyapatite. This approach increases bioactivity and enhances the potential of orthopedic applications. Hydroxyapatite obtained from biogenic sources has shown the capacity to retain various properties from their precursors, including chemical composition and pore structure. Further, material doping has been demonstrated to be an excellent method for improving surface properties of the obtained materials. In this regard, various dopants can enhance *in vitro* and *in vivo* bioactivity and biocompatibility, promoting bone regeneration while also improving the mechanical properties of the synthesized material. This study aims to present an optimal synthesis method for hydroxyapatite using natural sources, which can be further applied in medical applications without exhibiting any adverse effects on the human body. Additionally, the research investigated the potential of enhancing these materials with different dopants to improve the antimicrobial properties of medical applications. The synthesized materials have been therefore applied to a high-purity titanium substrate (> 99% Ti) using the Matrix-Assisted Pulsed Laser Evaporation (MAPLE) technique. To confirm the success of this deposition process, the samples were examined using Scanning Electron Microscopy.

GREEN SYNTHESIS OF ZINC, MAGNESIUM, AND COPPER OXIDE NANOPARTICLES USING ORANGE PEEL EXTRACT

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ABSTRACT

Lately, nanotechnology has seen significant growth in materials science applications, particularly in environmental and pharmaceutical domains. Nanoparticles (NPs) have gained extensive research interest due to their unique properties generated by their nanoscale morphology. In this direction, metal oxide NPs, easily incorporated into scaffold fabrication, have proven encouraging effects in enhancing the antibacterial, anticancer, antioxidant, and antifungal properties of materials.

Considering this, in wound healing and soft tissue engineering, the most studied metal oxide NPs include gold (Au), nickel (Ni), platinum (Pt), silver (Ag), palladium (Pd), zinc (Zn), and copper (Cu). These NPs can be synthesized through conventional (physical or chemical) methods or green synthesis approaches. However, environmental impact remains a primary concern in NP synthesis. While chemical and physical methods are widely used, they often involve toxic precursors that may induce carcinogenic and environmental risks. Thus, green synthesis offers a promising alternative, utilizing non-toxic reagents derived from fungi, plants, bacteria, yeasts, and algae. Plant-derived phytochemicals and biomolecules serve as stabilizing and reducing agents in NP formation, potentially reducing toxicity, preventing agglomeration, and enhancing antimicrobial activity of scaffolds through synergistic effects.

This study focuses on the successful green synthesis of zinc, magnesium, and copper oxide nanoparticles. Specifically, orange peel extract is employed as both a capping and reducing agent in the production of these nanoparticles.

MAGNETIC BIOACTIVE GLASS: SYNTHESIS, CHARACTERIZATION AND IN-VITRO BIOACTIVITY EVALUATION

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ABSTRACT

Bioactive glasses (BGs) are a class of advanced materials known for their ability to bond with both hard and soft tissues, making them highly valuable in medical applications. They are widely used in tissue engineering, particularly for bone repair and regeneration due to their biocompatibility and ability to stimulate cellular activity.

In recent years, there has been a growing trend in the synthesis of bioactive glasses with enhanced properties, such as increased porosity and nanoscale dimensions, to improve their bioactivity and effectiveness in medical treatments. This shift towards more sophisticated and tailored bioactive glass materials aims to address the challenges of tissue regeneration and drug delivery, opening new avenues in regenerative medicine. [1-3]

The aim of this study was to synthesize nanoparticles of Fe_3O_4-BG and characterize them. Magnetite nanoparticles (Fe_3O_4) were successfully incorporated into bioactive glass ($51SiO_2$-$18CaO$-$20Na_2O$-$4P_2O_5$-$7Fe_3O_4$ mol%) via sol-gel method.

The Fe_3O_4-BG composite was immersed in Simulated Body Fluid (SBF) for in vitro bioactivity testing to evaluate its potential for bone regeneration. The SBF solution, designed to mimic the ionic composition of human blood plasma, was used to simulate physiological conditions. The composite was immersed in SBF for a period of 28 days at 37°C, during which changes in pH and electrical conductivity were monitored.

Additionally, the biomaterial was characterized using various techniques, including FTIR-ATR, SEM, TG-DSC and in-vitro bioactivity testing.

The results suggest that the Fe_3O_4-MBG composite not only supports bone tissue regeneration but also holds promise for hyperthermia therapy. This study enhances our understanding of how bioactive materials, such as bioglass and magnetite nanoparticles, interact with a simulated physiological environment, providing valuable perspectives for their biomedical applications.

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SYNTHESIS AND CHARACTERIZATION OF beta-TCP Doped WITH GALLIUM

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ABSTRACT

In recent decades, orthopedic prostheses have become increasingly important as the number of bone defects and joint damage has risen, driven by the aging global population. One of the most dynamic and important fields of research in materials science is the creation of new multifunctional bioactive materials to be used in the field of orthopedics. These new materials have significantly contributed to the scientific progress of the 21st century [1]. From a philosophical perspective, extending life expectancy requires finding biological solutions to various biomedical problems, including orthopedic ones, which were previously addressed by mechanical methods. Thus, starting from the late 1990s, research in the field of biomaterials has focused more on tissue regeneration than on their replacement [2].

Calcium phosphates, especially beta-tricalcium phosphate (β-TCP), are known for their excellent compatibility with bone tissue and their ability to stimulate bone regeneration. Tricalcium phosphate (TCP) is found in two distinct polymorphic crystalline forms: α-TCP (hexagonal form) and β-TCP (orthorhombic form). β-TCP is preferred in bone cements and bio-ceramics for its superior stability and resorption in comparison to α-TCP. Doping phosphate bioceramics with ions such as gallium (Ga) enhances their properties, expanding their applicability in regenerative medicine. β-TCP doped with Ga^{3+} has demonstrated effective antibacterial properties, promoting bone regeneration without toxicity [1, 3, 4, 5]. The combination of gallium and calcium phosphates, especially gallium/β-TCP, shows considerable potential in the field of regenerative medicine and orthopedics [5].

The present study aims to obtain ceramic masses based on β-TCP doped with gallium. We synthesized β-TCP doped with 0.5% gallium, using the coprecipitation method. The powder thus obtained was characterized using X-ray diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Raman spectroscopy, Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDAX). Furthermore, the powder was characterized in vitro by MTT and GSH alkaline phosphatase tests.

Keywords: β-TCP (beta-tricalcium phosphate), gallium, coprecipitation method, regenerative medicine.

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AN INVESTIGATIVE STUDY OF CHEMISTRY AND ANTIMICROBIAL ACTIVITY OF MORINGA OLEIFERA SEEDS ETHANOL EXTRACT

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ABSTRACT

Moringa oleifera commonly known as drumsticks tree or horseradish tree, has been widely recognized for its extensive range of medicinal properties. This study aims to investigate the antimicrobial efficacy of ethanol extract derived from *M. oleifera* seeds. The seeds were subjected to ethanol extraction with the help of Soxhlet apparatus using ethanol solvent, and the resultant extract was tested for its antimicrobial activity against a variety of gram-positive and gram-negative bacteria. The antimicrobial properties were assessed using the agar well diffusion method to determine the zone of inhibition.

The bioactive compounds of *M. oleifera* seeds ethanol extract were analyzed by LC-MS technique in which Chlorogenic acid, Ricinolic acid, Naringenin, Coronaric acid, oxooctadecadienoic acid, Methyl stearate, Epicatechin, Linoleic acid, Niazirin and 2-phenyl methoxy butan-1,4-diol were found. The antimicrobial investigation was done by agar well diffusion method against food borne pathogen such as *Staphylococcus aureus*, *Bacillus subtilis* and *Escherichia coli* used. The result of antimicrobial studies revealed the significant activity against *S. aureus* and *B. subtilis* demonstrating notable inhibitory effects on microbial growth.

In conclusion this study indicates that ethanol extract from *M. oleifera* seeds exhibit notable antimicrobial activity at elevated concentrations. This highlights its promise as a natural antimicrobial agent, warranting further exploration for potent therapeutic uses.

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SODIUM LIGNOSULFONATE DERIVED POROUS CARBON FOR ENERGY STORAGE AND ACCUMULATION DEVICES

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ABSTRACT

To enhance the performance of energy storage and accumulation devices, carbon nanostructures are actively used as electrode materials and conductive additives. In this context, the study of physicochemical methods for synthesizing new carbon materials is of great interest [1]. For example, Super C65 carbon black is successfully used as a conductive additive in metal-ion batteries [1]. This work attempts to obtain electrode materials and conductive additives from sodium lignosulfonate.

One of the common wastes in the production of cellulose materials is a black liquor, which is formed during the sulfate pulping of wood (treatment with an aqueous solution of NaOH and Na_2S). Black liquor is a liquid mixture of lignin, extractives (sodium salts of resin and fatty acids), and carbohydrates. By acidifying the solution and filtering the liquor, sodium lignosulfonate can be obtained, which can be used as a raw material for synthesizing carbon materials. In this study, conductive carbon particles were obtained from sodium lignosulfonate. The material was provided by the Department of Paper and Cardboard Technology at St. Petersburg State University of Technology and Energy. The carbonization of sodium lignosulfonate was carried out in a quartz reactor in a horizontal furnace under a nitrogen atmosphere. The material was annealed at temperatures ranging from 600°C to 900°C in 100°C increments (6 hours) and at 1 000°C (12 hours), following the methodology described in [2]. The carbons were thoroughly washed from salts, monitoring the conductivity of the filtrate using a conductometer, and dried at 80°C for one day.

All obtained carbon materials were characterized using modern instrumental methods: transmission and scanning electron microscopy (TEM and SEM), X-ray photoelectron spectroscopy (XPS), low-temperature nitrogen physisorption , and simultaneous thermal analysis (STA). Additionally, the specific electrical resistance of the materials was measured using the standard four-probe method [3], and the results were compared with data for Super C65 carbon black and activated carbon YEC-8B (Table 1).

Table 1. Specific electrical resistance of carbon materials

Matherial	ρ, Ohm*cm
Super C65	0,09
YEC-8B	0,11
C_{600}	12
C_{700}	0,25
C_{800}	0,11
C_{900}	0,11
C_{1000}	0,05

It was shown that the carbon obtained by annealing lignosulfonate at 1 000°C has the best conductivity, surpassing the characteristics of commercial carbon black and coal. The carbon materials were tested as electrode components and conductive additives in a three-electrode cell using aqueous solutions of KOH 3M and 1M Na_2SO_4 with a Bio-Logic SAS VSP potentiostat. The capacitive characteristics were compared with each other. The results showed that increasing the conductivity of electrode materials does not always lead to improved efficiency of energy storage and accumulation devices, highlighting the importance of selecting the optimal electrolyte for specific electrode materials and conductive additives. Nevertheless, it can be concluded that carbons obtained at temperatures of 700°C, 800°C, 900°C can be used as electrode materials in supercapacitors and metal-ion batteries due to their high conductivity. In particular, sodium lignosulfonate samples were activated at a temperature of 800°C with KOH to increase the surface area of the material (Table 2). Upon activation with KOH, an increase in the surface area of the sample compared to the unactivated material and an increase in the proportion of micropores are observed. The increase in the surface area of the sample as a result of activation may contribute to the improvement of capacitive characteristics [4].

Table 2. Porous characteristics from nitrogen physisorption data

Conditions	S, m^2/g	S_{micro}, m^2/g	V_{tot}, cm^3/g	V_{micro}, cm^3/g
800°C (12 h) without KOH	240	220	0,21	0,13
800°C+KOH (1,5 h)	2600	2500	1,4	1,2
800°C+KOH (4,5 h)	2500	2100	1,5	0,9
800°C+KOH (6 h)	2300	1600	1,5	0,8

The carbon obtained by annealing at 1000°C may serve as a substitute for Super C65 carbon black; however, further research is needed to evaluate its effectiveness with various electrolytes, including organic ones.

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INVESTIGATING OF TOXICITY OF EXTRACTS FROM VEGETATIVE ORGANS OF THE SPECIES BRYOPHYLLUM PINNATUM (CRASSULACEAE)

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ABSTRACT

Intoduction:

The species *Bryophyllum pinnatum* (Crassulaceae) is a succulent, xeromorphic (1), decorative but also medicinal plant. It is used in traditional African medicine to treat various conditions. It has been investigated for its properties: anti-inflammatory, anti-asthmatic and antitussive, anti-convulsant, anti-diarrheal, antifungal, antimicrobial, anti-urolithiasis, anti-cancer, hypocholesterolemic, hypoglycemic, etc. Previous phytochemical analysis have highlighted the active principles: phenols alkaloids, flavonoids, saponins, tannins, carotenoids, glycosides, lectins, coumarins, etc. [2,3].

The purpose of the work

The above-ground vegetative organs of the plant were investigated macroscopically, microscopically in order to establish the species identity. Plant extracts were obtained to investigate the toxicity on plant cells and nauplii of *Artemia franciscana* Kellog test.

Material and methods

Microscopic analysis was done on superficial preparations obtained from leaves. Transverse sections through leaves and stems were used to highlight the type of anatomical structure and chemical composition. The dyes used were iodine green and alum carmine (3). The analysis was done with a Leica DMS1000 digital microscope and a Nikon Labphot II optical microscope. The toxicity of the hydroalcoholic extracts from the leaves and stem was tested by the *Triticum* test and by the *Artemia* using 5 concentrations (1%, 0.5%, 0.1%, 0.05% and 0.01%).

Result

In the leaves of the species with a homogeneous structure, phenolic idioblasts and anisocytic stomata distributed on both sides of the leaf were evident. Idioblasts in large numbers were observed in the mature stem with secondary structure.

The *Triticum* bioassay showed that the two extractive solutions from leaves and stem respectively had a strong inhibitory effect on root elongation in the concentration range 1-0.5% ($p < 0.0001$),but the one from the stem had a stronger effect compared to the one, obtained from the leaves.

Artemia bioassay demonstrated that the extractive solutions obtained from the leaves and respectively the stems of *Bryophyllum pinnatum* do not present toxicity to animal organisms.

Conclusions

Microscopic analysis highlighted the presence of idioblasts and confirmed the identity of the species. Hydroalcoholic extractive solutions from the leaves and stems of *Bryophyllum pinnatums* species proved to be non-toxic on *Artemia franciscana* Kellog nauplii and with reduced inhibitory effect on root elongation.

Keywords: *Bryophyllum pinnatum*, hydroalcoholic extracts, toxicity.

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PROSPECTS FOR THE USE OF CARBON SORBENT OBTAINED FROM RICE HUSK FOR THE SORPTION OF PETROLEUM VOLATILE ORGANIC COMPOUNDS WITH THEIR SUBSEQUENT ANALYSIS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY WITH THERMAL DESORPTION

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ABSTRACT

Anthropogenic activities and industrialization in recent decades have put increasing pressure on the environment, emitting huge amounts of pollutant. Various petroleum spills during oil exploration and transportation have an extremely negative impact on the environment and its inhabitants. Adsorption using biomass waste is one of the most effective methods to reduce the concentration of toxicants because of several reasons: low cost, the ability to remove a wide range of pollutants and the possibility of production wastes recycling.

It is proposed in the investigation to use an activated carbon adsorbent obtained from rice husk. The physico-chemical characteristics of the sorbent were obtained in order to verify its promising use for petroleum volatile organic compounds (VOC) capture.

The specific surface area of the sorbent is ~600 m^2/g, mainly the surface of the sample is represented by mesopores with a diameter of 2÷10 nm. The chemical composition of the sorbent surface was analyzed using X-ray fluorescence. Lines of oxygen, nitrogen, carbon, calcium and silicon are observed in the survey spectra. The sorbent belongs to the category of mesoporous, and it is possible to predict a high efficiency of adsorption of petroleum VOC vapors.

The kinetics of petroleum vapors adsorption was studied by gas chromatography-mass spectrometry with thermal desorption. The sorbent characteristics were evaluated based on the total area of the components on the chromatogram. The best approximation is given by a pseudo-*n*th order model with a reaction order value of 2.5. This is probably due to the fact that the kinetics of sorption changes over time. The maximum saturation in this case is mmax = 0.185 g of VOC per g of sorbent.

The reproducibility of the experiment and the completeness of the desorption of VOCs from the sorbent are evaluated.

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TIO_2 – SUPPORTED PD, AG AND PD-AG NANOPARTICLES: PREPARATION, CHARACTERIZATION AND PHOTOCATALYTIC H_2 EVOLUTION FROM WATER SPLITTING

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ABSTRACT

The catalyst bimetallic nanoparticles are more promising than the monometallic ones because of the estimated synergistic effects. Bimetallic nanoparticles have often exhibited higher catalytic activity compared to monometallic ones [1, 2]. Controlling the size, shape and dispersion of metal nanoparticles is essential for enhanced catalytic activity [3].

Mono (Pd, Ag) and bimetallic (Pd-Ag) nanoparticles protected by PVP were synthesized using a modified protocol of the alkaline polyol method [2]. The physicochemical properties of the obtained nanoparticles, as well as of the Pd, Ag and Pd-Ag catalysts supported on TiO_2, were also investigated using different methods such as TEM (Transmission Electron Microscopy), fractal analysis, XRD (X-ray powder diffraction), XPS (X-ray Photoelectron Spectroscopy), UV-Vis spectroscopy and CO chemisorption. In this way, information was obtained to elucidate the morphology, structure and chemical state of the obtained catalytic materials. To investigate the metal-support interaction and the reducibility of the catalysts, H_2-TPR (Temperature-programmed reduction with H_2) measurements were performed.

TEM images were analysed using the box-counting method. All samples exhibit fractal behaviour. Fractal dimension (Do) of images converted into black balls sets together with fractal dimension dependence on grey-level threshold were computed. The one-plateau fractal dimension curve is obtained for Pd and Ag samples, meanwhile the Pd-Ag sample exhibit the two-plateaus behaviour. The fractal dimension of the black and white images is greater for the Pd-Ag nanoparticles (1.854±0.018) then for the Pd (1.427±0.457) or Ag nanoparticles.

Testing of catalytic activity in the photochemical water splitting reaction was performed. It was observed that Pd, Ag and Pd-Ag nanoparticles dispersed on TiO_2 showed a good and stable activity for photocatalytic water splitting reaction. Therefore, Pd-Ag/TiO_2 can be successfully used as a catalyst due to the synergistic effect between silver and palladium nanoparticles.

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