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"PRIORITIES OF CHEMISTRY FOR A SUSTAINABLE DEVELOPMENT"

PRIOCHEM

22nd edition



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FOREWORD
22nd International Symposium "Priorities of Chemistry for a Sustainable Development"
PRIOCHEM XXII

21–23 October 2026, Bucharest, Romania

It is with great pleasure that we present the Book of Abstracts of the 22nd International Symposium " It is with great pleasure that we present the Book of Abstracts of the 22nd International Symposium "Priorities of Chemistry for a Sustainable Development" (PRIOCHEM XXII), organized by the National Institute for Research and Development in Chemistry and Petrochemistry – ICECHIM Bucharest, on 21–23 October 2026.

Over more than two decades, PRIOCHEM has developed into an international scientific forum dedicated to advancing chemistry and related disciplines, promoting interdisciplinary dialogue, and strengthening cooperation between research institutions, universities, and industry. Throughout its successive editions, the symposium has remained committed to a fundamental principle: scientific progress acquires its greatest value when knowledge is transformed into solutions addressing the challenges faced by society. The 2026 edition continued this tradition, placing particular emphasis on the contribution of chemistry, materials science, and biotechnology to sustainable development, resource efficiency, environmental protection, and technological innovation. At a time when climate change, resource scarcity, environmental pollution, and the transition towards a circular economy demand increasingly complex solutions, interdisciplinary research and international cooperation have become more important than ever.

PRIOCHEM XXII brought together 147 unique participants, including 102 participants from Romania and 45 international participants representing 20 countries and territories outside Romania. The symposium was organized in a hybrid format, combining direct scientific interaction at ICECHIM's headquarters with online participation, thus facilitating the involvement of a geographically diverse scientific community. International participation included researchers and specialists from **Türkiye, the Republic of Moldova, India, Malaysia, Poland, Algeria, Bulgaria, Croatia, France, Serbia, Germany, Ireland, Italy, Iran, Morocco, Nigeria, the United Kingdom, Ukraine, South Korea, and Taiwan**. The largest international representations came from Türkiye, the Republic of Moldova, India, Malaysia, and Poland, reflecting the symposium's ability to attract scientific contributions from different regions and research communities.

The international dimension of PRIOCHEM XXII was further strengthened by the participation of researchers affiliated with recognized academic and scientific institutions, including **University College Dublin (Ireland), the Medical University of Lublin (Poland), the University of Messina (Italy), Brunel University London (United Kingdom), Universiti Malaysia Perlis (Malaysia), and the Vinča Institute of Nuclear Sciences (Serbia)**, alongside representatives of universities and research organizations from Türkiye, India, and other participating countries. Romanian participation was equally diverse, bringing together researchers and academics from the National University of Science and Technology POLITEHNICA Bucharest, the University of Bucharest, the University of Agronomic Sciences and Veterinary Medicine of Bucharest, the University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca, Gheorghe Asachi Technical University of Iași, Ștefan cel Mare University of Suceava, the University of Craiova, and the Ferdinand I Military Technical Academy. Research institutions were represented by ICECHIM Bucharest, the National Institute for Research and Development in Biological Sciences (INCDSB), the National Institute for Research and Development in Construction, Urban Planning and Sustainable Spatial Development (URBAN-INCERC), the National Research and Development Institute for Cryogenic and Isotopic Technologies (ICSI Râmnicu Vâlcea), the National Institute for Research and Development in Textiles and Leather (INCDTP), the National Institute for Aerospace Research "Elie Carafoli" (INCAS), the National Institute for Research and Development on Marine Geology and Geoecology (GeoEcoMar), the National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection (ICPA Bucharest), the "C. D. Nenitzescu" Institute of Organic and Supramolecular Chemistry (ICOS), the Institute of Chemical-Pharmaceutical Research and Development (ICCF Bucharest), and CEPROCIM S.A. The medical and agricultural research communities were also represented by the Regional Institute of Oncology Iași and the Academy of Agricultural and Forestry Sciences "Gheorghe Ionescu-Șișești" (ASAS). The symposium welcomed representatives of key national authorities and organizations supporting research and innovation, including the National Authority for Research (ANC), the Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI), and the

Romanian State Office for Inventions and Trademarks (OSIM). Additional participation came from the Romanian Chemical Engineering Society (SIChR), the Romanian Inventors Forum, the Association for Integrative Education and Development for the Future (ADEIV), the Centre for Research and Innovation in CBRNE Defence (CCIACBRNE), and Radio Romania.

The scientific programme was structured around three major research directions: **Multifunctional Materials, Nanocomposites, Innovative Technologies and Cultural Heritage Conservation; Bioresources, Biotechnologies and Biorefining; and Promoting Climate Neutrality and Resilience Through Agriculture – AgroCliN.** These complementary themes illustrate the increasingly interconnected nature of contemporary scientific challenges and the essential role of chemistry in developing innovative and sustainable solutions. A particular highlight of PRIOCHEM XXII was the valuable contribution of its plenary and invited speakers, representing established scientific institutions and diverse areas of expertise. Together, these contributions offered valuable perspectives on the relationship between fundamental research, scientific interdisciplinarity, technological development, and practical applications. They also demonstrated the importance of scientific dialogue between established researchers, emerging scientists, and specialists working in complementary fields.

An important feature of this edition was the integration of scientific sessions with thematic workshops and project-related activities. The satellite events held on 20 October provided opportunities to exchange expertise, discuss ongoing research initiatives, and strengthen interdisciplinary collaboration. Particular attention was given to environmental protection through the **AquaMat research programme** and to climate-resilient agriculture through the **AgroCliN Centre of Excellence**, alongside discussions on sustainable construction materials, biotechnology, cultural heritage conservation, food safety, and technology readiness.

Beyond scientific dissemination, PRIOCHEM XXII continued to promote innovation and the practical valorisation of research results. The third edition of **"Tech Talks – Meet the Mentors!"**, organized in collaboration with the Romanian State Office for Inventions and Trademarks (OSIM), focused on intellectual property protection and its essential role in transforming scientific discoveries into technological and economic value. The involvement of OSIM specialists also provided researchers with practical insights into patent protection, highlighting the importance of identifying and safeguarding potentially valuable inventions before their public disclosure. Supporting the next generation of scientists remains one of the central objectives of PRIOCHEM. The symposium provided young researchers with opportunities to present their results, interact with experienced specialists, and develop their scientific communication skills. The interactive **"My Poster in 100 Seconds!"** initiative, together with the scientific awards granted during the closing ceremony, reflected our commitment to encouraging creativity, scientific excellence, and the professional development of early-career researchers.

The contributions gathered in this Book of Abstracts represent the diversity, scientific quality, and collaborative spirit that characterized PRIOCHEM XXII. We hope that they will serve not only as a record of the research presented during the symposium, but also as a source of inspiration for future investigations, interdisciplinary collaborations, and innovative scientific approaches.

On behalf of the Scientific Committee, we would like to express our sincere appreciation to all plenary and invited speakers, authors, participants, and session chairpersons for their valuable contributions. Their expertise, enthusiasm, and willingness to share knowledge are the foundation of the symposium's continued development. We gratefully acknowledge the support of the Romanian Ministry of Education and Research and the National Authority for Research, as well as the patronage of the Academy of Romanian Scientists. Our appreciation also extends to the Romanian Chemical Society, the C. D. Nenițescu Foundation, and the Association for Integrative Education and Development for the Future (ADEIV), together with our sponsors, institutional and publication partners, and Radio România Cultural, whose contributions supported the successful organization and visibility of the event. As we conclude the 22nd edition of PRIOCHEM, we look forward to further strengthening the scientific connections established during the symposium and to welcoming both longstanding collaborators and new participants to future editions.

We firmly believe that the future of sustainable development depends on our collective ability to connect scientific knowledge, technological innovation, and international cooperation. PRIOCHEM will continue to provide a meeting place where these connections can grow, new partnerships can emerge, and scientific ideas can become the foundation for meaningful progress.

The organizers

PLENARY SESSION & INVITED LECTURES





Prof. Dr. Eng. Tănase Dobre

National University of Science and Technology POLITEHNICA Bucharest, Romania

Romanian Chemical Engineering Society

Tanase G. Dobre, graduated from Bucharest Politehnica University in Industrial Chemistry and Processes Engineering, begun as an engineer by working in production, design and research in Printed Boards Technology, at the factory Felix Computers Bucharest. He gains, at Bucharest Politehnica University, a Chemical Engineering Assistant position starting his university activity. The topic of his PhD thesis was in modelling and experimental investigation of the wetted mobile packed bed as a basic structure in heat and mass transfer enhancement. He was strongly involved with the modelling and experimental investigation aspects concerning the transposition to the industrial scale of the process concerning the sulphur separation from the flotation suspensions. He was a member of a national consortium with a research object in the field of heat pipes where he insisted, experimentally and through modelling, for their use in temperature control in chemical reactors.

On the way of his university promotion, he kept in the foreground transfer phenomena and modelling and simulation of processes, for research and equipment design. About six years he was in a strong cooperation with ENSCh Montpellier with works in membrane processes modelling and simulation. His main research interest covers mathematical modelling and computer simulation of chemical and biochemical processes, stochastic processes, mass transfer within porous medium (membrane processes), mathematical modelling of air, soil and water pollution, intensive processes by heat and mass transfer enhancement, advances in separation processes computing, simulation, and experimental checking. He is a member of the Technical Sciences Academy of Romania and of Romanian Chemical Engineering Society, which he represents nationally and internationally, especially at the European Federation of Chemical Engineering.

FROM GENERALPROBLEM OF MODELING-SIMULATION-MONITORING TO DIESEL HYDRODESULFURIZATION

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Keywords: Modeling, Simulation, Monitoring, Diesel Hydrodesulfurization, LH Kinetics Models

Introduction: In all stages of the development and manufacturing of a product based on molecular scale transformations and separations, the modelling-simulation-monitoring (MSM) triad is fundamental, because [1]: 1) it reduces manufacturing costs, 2) it reduces time and costs in all the stages of process life-cycle, 3) it increases process efficiency, 4) it allows a better and deeper understanding of the process and its operation, 5) it is used as the support for the solutions adopted during the process development and exploitation, 6) it insures an easy technological transfer of the process, 7) it increases the quality of process management, 8) it reveals abilities to handle complex problems,9) it improves the safety of the plants, 10) it markets new products faster, 10) it reduces waste emissions while the process is being developed, 11) it improves the quality of the products,12) it insures a highly qualified training of the operators.The case study, here analysed through the MSM couple, considers the catalytic hydrodesulfurization of diesel fuel for a high-purity product in terms of sulphur content. Environmental requirements [2, 3] imposed this condition for diesel fuel. The diesel hydrodesulfurization process is a strongly complex process because, in addition to the sulphur compounds, catalytic gas-liquid hydrogenation at pressure and temperature, simultaneously occurs hydrogenation of nitrogen compounds, oxygenated compounds as well of aromatics and olefins.

Materials and methods: The analysis of factors influence in the complex hydrodesulfurization process has found a modelling gate in which the process is controlled by the kinetics of hydrogenation processes, occurring on catalytic sites of catalyst [4]. It was thus adopted, depending on the hydrogenated reactant, the Power Law (PL) or Langmuir-Hinshelwood (LH) formal kinetics models of the 4 major hydrogenations.With these kinetic models and literature data for their parameters, the reactor model was built and simulated with industrial-level input data. The results showed that sulphur and nitrogen contents in diesel fuel can be achieved below 10 ppm. Two long-term monitoring sets of an industrial reactor are presented and commented on. in terms of process controlling effort, so that, to ensure the performance to have below 10 ppm sulphur compounds in the reactor product.

Results: When an industrial reactor model with LH reactions kinetics is coupled with monitored, data it is possible to obtain the identification of the adjustable parameters of kinetics expression of sulfur and nitrogen hydrogenation.The parameters thus identified are specific to the used catalyst and to the operating conditions. Dynamics of experimental (monitored) and predicted concentrations of sulfur and nitrogen compounds in diesel fuel at the reactor outlet, which are shown graphically, highlight that the data predicted cover the experimental data quite well. State of reactor exit compounds concentrations is observed and commented by reactor exploitation conditions [5] respect to LH kinetics.

Conclusions: Predicted curves of ci/ci0 (i= sulfur compounds, nitrogen compounds, aromatics and respectively olefines) depending on catalyst volume at catalytic bed temperature of 600 0K, where n = 1, diesel load of 100 m3/h and kinetic parameters of Arrhenius equation were selected based on data from the literature, indicated a catalyst volume of 60 m3 required to reduce the sulfur concentration of diesel fuel from 6000 ppm to 6 ppm. This value of catalyst volume agree with those corresponding to an industrial reactor. Predicted curves of species hydrogenation degrees depending on mean bed temperature at V = 60 m3 revealed a higher sensitivity to this temperature of the hydrogenation of olefins, aromatic and nitrogen compounds compared to that of sulfur compounds.

Two case studies of monitoring data for an industrial reactor for 50 respectively for 67days were provided. The model adjustable parameters in terms of kinetic parameters of Arrhenius equation were estimated by minimizing

the sum of squares of the differences between the monitored and predicted values of the concentrations of sulfur and nitrogen compounds at the reactor outlet. The results obtained suggested that the catalyst had almost equal specificity for the hydrogenation of sulfur and nitrogen compounds.
It is necessary to consider how these adjustable parameters evolve so that the reduction in catalyst activity can be correctly assessed.

Acknowledgements*: This work was supported in terms of reactor monitoring data by Petromidia SA Romanian refinery.*

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Assoc. Prof. Dr. Aurel DIACON

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Associate Professor Aurel Diacon is a researcher and academic at the Military Technical Academy "Ferdinand I" in Bucharest, Romania. His scientific activity is focused on polymer chemistry, advanced functional materials, and the development of innovative polymer-based systems for technological applications.

His research interests include polymer synthesis and characterization, controlled polymerization processes, nanocomposites, functional coatings, and hybrid organic–inorganic materials. Particular attention is devoted to the integration of advanced nanomaterials into polymeric matrices to obtain enhanced structural and functional properties.

His scientific contributions include research on stimuli-responsive polymeric systems, functional nanocomposites, and MXene-based materials, including their potential applications in electromagnetic interference shielding. Through interdisciplinary collaborations, he has contributed to scientific publications addressing emerging challenges in materials science and engineering.

His research activities reflect the growing importance of advanced polymeric and two-dimensional materials in the development of multifunctional systems for specialized technological applications.

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MXENE AS VERSATILE COMPONENT IN MULTIFUNCTIONAL COMPOSITE MATERIALS

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Keywords: versatility; composite materials; MXenes; EMI shielding; antibacterial protection

Introduction: Composite materials underpin modern defence technologies, and their versatility – one platform re-engineered for a different mission – is the theme of this contribution. Our group pursues this versatility along two complementary lines: two-dimensional MXenes dispersed in polymeric matrices for electromagnetic interference (EMI) shielding, soft actuation and antibacterial protection [1], and polyurethane-bound pyrotechnic composites designed through EXPLO5 thermochemical modelling for cloud seeding and hail mitigation [2]. This work addresses the first line, where functionalisation, encapsulation and matrix-tailored integration tune one family of nanocomposites across electromagnetic, mechanical and biological functions.
Materials and methods: Nb_2AlC, $Mo_2Ti_2AlC_3$ and Ti_3AlCN MXenes were used either pristine or chemically functionalised after HF etching, to introduce –SH, $–NH_2$ and –OH/oxirane groups. They were integrated into polyurethane (PUR) foams obtained from poly(ethylene terephthalate) depolymerisation, flexible PUR films and coatings, poly(MMA-*co*-HPMA) microcapsules, soap-free emulsion polymer colloids dispersed in epoxy resins, and photopolymerised hydrogels containing polypyrrole (PPy) or poly(*N*-isopropylacrylamide) (pNiPAM). Characterisation addressed morphology, structure, mechanical, swelling and electrical behaviour, antimicrobial activity, cytocompatibility and EMI shielding effectiveness.
Results: Pristine Nb_2AlC-loaded PUR foams were lightweight, porous and effective EMI shields with preserved structural integrity. Flexible PUR films and coatings based on $Mo_2Ti_2AlC_3$ combined flexibility with shielding effectiveness; encapsulating $Mo_2Ti_2AlC_3$ in poly(MMA-*co*-HPMA) microcapsules stabilised the filler and further improved shielding without loss of flexibility or strength [3]. Soap-free emulsion Nb_2AlC–polymer colloids promoted intercalation and exfoliation and improved dispersion in epoxy matrices, whose response shifted from electromagnetic transparency to absorption with colloid concentration. Photopolymerised $Mo_2Ti_2AlC_3$–PPy hydrogels combined low swelling with improved electrical and mechanical performance [4], while Ti_3AlCN–pNiPAM hydrogels added thermoresponsive actuation. Thiol-functionalised MXenes with in-situ generated silver nanoparticles yielded photopolymerised antimicrobial hydrogels [5], confirming that post-etching functionalisation improves both biocompatibility and antimicrobial activity.
Conclusions: A single toolbox – functionalisation, encapsulation and matrix engineering – delivered tunable EMI shielding, thermoresponsive actuation and antibacterial surfaces from the same family of MXene fillers, confirming the versatility required by multi-mission defence materials and supporting their extension towards CBRN protection and decontamination.

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Prof. Dr. Saskia van RUTH
University College Dublin, Ireland

In August 2023, Saskia van Ruth joined UCD as Full Professor of Food Supply Chain Integrity. Over the past two decades her research and teaching in various universities has focused on the integrity in food supply chains, food fraud prevention and food authentication. She worked in this area before at Wageningen University, Wageningen Research, Queen's University Belfast and University College Cork.

During her research and teaching career, which covers over 30 years, she has initiated, led and conducted hundreds of projects with a wide variety of stakeholders from multinational food industry actors to regulators, from media companies to the hospitality sector, from farmers in China to privately-owned vineyards in South Africa. In the past ten years, this involved this included 19 EU projects, i.e. FFraud-ER, 2 BTSF food fraud courses development projects, EUCHINASAFE, Phasmafood, AuthentNet, FoodIntegrity, Spiced, AuthenticFood, PIMMS, QSAFFE, MoniQA, MacOils, Feeding Fat Safety, Fat Authentication, Cost Action SensorFint, Cost Action Saffronomics, Cost Action Farm Animal Proteomics, and Cost Action Feed for health. She coordinates the European initiative EFF-CoP, a project which establishes and mobilises the European Food Fraud Community of Practice - a project starting from January 2025. During her career she has (co-)authored over 330 scientific publications. Furthermore, she has taught thousands of students in the area of food integrity, food (analytical) chemistry, and sensory science from primary school pupils to BSc, MSc, and PhD students, food and feed supply chain actors, as well as regulators and policymakers. Furthermore, she have been lucky to mentor over 175 PhD/MSc/BSc thesis students so far.

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BUILDING COMMUNITIES THAT MOVE FOOD SCIENCE FORWARD

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A Community of Practice (CoP) is more than a network of people; it is a space where knowledge is shared, connections grow and new action emerges. This presentation deals with two of these CoPs:

The European Food Fraud Community of Practice (EFF-CoP) and the FUSE Network. EFF-CoP is a dynamic community connecting researchers, food businesses, authorities and other stakeholders to improve food fraud prevention and detection. It brings people together through shared resources, practical activities, training, living labs and new forms of collaboration.

The FUSE Network takes a broader food-systems perspective, connecting expertise in food processing, human health and sustainable food systems. It creates space for researchers and stakeholders to exchange knowledge and develop connections across disciplines and sectors.

The lecture explores how these networks grow, adapt and create value by connecting people, knowledge and action, and what this means for future European collaboration in food science.



Prof. Dr. Habil. Ileana Cristina COVALIU-MIERLĂ

National University of Science and Technology POLITEHNICA of Bucharest

Professor Ileana Cristina Covaliu-Mierlă is a Professor and doctoral supervisor in Environmental Engineering at the National University of Science and Technology POLITEHNICA Bucharest. Her academic and scientific activity focuses on environmental protection, sustainable technologies, and the development of advanced materials for pollution prevention and remediation.

Her research interests include wastewater treatment, the synthesis and characterization of nanostructured materials, adsorption processes, and innovative technologies for removing organic and inorganic pollutants from contaminated water. Particular attention is devoted to environmentally responsible materials and the integration of nanotechnology into conventional and emerging water treatment processes.

Professor Covaliu-Mierlă has participated in research and innovation projects addressing environmental challenges, including the development of smart materials, hybrid nanomaterials, and enhanced flotation technologies for wastewater purification.

Her scientific contributions reflect a multidisciplinary approach combining chemistry, materials engineering, and environmental technologies, with an emphasis on developing practical, sustainable solutions for environmental protection and resource management.

FROM NANOMATERIAL DESIGN TO WASTEWATER TREATMENT SYSTEMS: ADVANCED STRATEGIES FOR POLLUTANTS REMOVAL

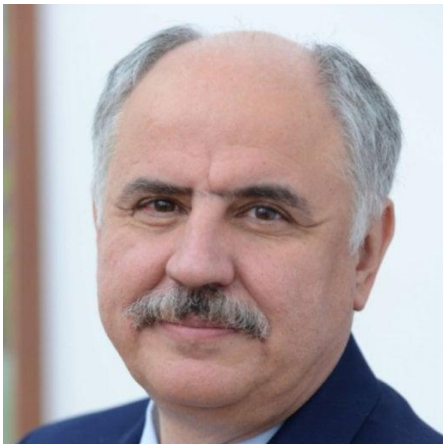
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Keywords: nanomaterials; adsorption; flotation; pollutant removal; wastewater treatment

Introduction: The presence of heavy metals, organic contaminants, and other persistent pollutants in wastewater creates a need for efficient and adaptable treatment technologies. Engineered nanomaterials offer tunable surface chemistry, high specific surface area, and functional properties that can improve contaminant capture and separation. This contribution examines the transition from nanomaterial design to integrated wastewater treatment systems, focusing on adsorption and nanomaterial-assisted flotation [1,2].
Materials and methods: The analysis addresses metal-oxide and magnetic nanomaterials, functionalized mineral supports, and hybrid adsorbents, considering their structural and morphological properties and potential application in aqueous treatment. Adsorption and flotation are discussed in relation to pH, contact time, material dosage, pollutant characteristics, bubble–particle interactions, and opportunities for material recovery and reuse.
Results: Nanomaterial composition, surface functionality, and morphology influence pollutant uptake through mechanisms such as electrostatic attraction, surface complexation, and ion exchange. Integrating functional materials with flotation may improve the separation of contaminant-bearing particles, while magnetic properties can facilitate adsorbent recovery. The relative advantages of these approaches depend on wastewater composition, operating conditions, treatment time, and the stability and regenerability of the materials. Quantitative performance claims require validation using comparable experimental data.
Conclusions: Nanomaterial-based adsorption and advanced flotation offer complementary routes toward more efficient wastewater treatment. Their integration may support pollutant removal, process intensification, and material recovery. Future work should prioritize real wastewater matrices, robust pilot-scale validation, reduced chemical and energy consumption, and environmental assessment of nanomaterial reuse and end-of-life management.

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Dr. Habil. Florin Oancea is Scientific Director and Senior Researcher at the National Institute for Research and Development in Chemistry and Petrochemistry (ICECHIM Bucharest), where he also leads the Bioproducts Research Group. With an extensive scientific background in biochemistry, biotechnology, and plant protection, his research focuses on the development of innovative bioproducts for sustainable agriculture and the circular bioeconomy.

His scientific interests include plant biostimulants, beneficial microorganisms, microbial biotechnology, and the valorisation of biological resources and agro-industrial by-products. His work integrates microbiology, biochemistry, and biotechnology to develop environmentally responsible solutions for agricultural productivity and resource efficiency.

Dr. Oancea has been involved in numerous national and international research and innovation projects, contributing to scientific publications, patents, and technological developments. He is also a habilitated doctoral supervisor in the field of biotechnology, actively supporting the education and professional development of young researchers.

UTILIZATION OF SYMBIOTIC COMMUNITIES OF BACTERIA AND YEASTS IN CIRCULAR BIOECONOMY.

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This presentation illustrates the potential of symbiotic communities of bacteria and yeasts (SCOBY) as multifunctional microbial platforms within the circular bioeconomy. It conceptually traces the progression from natural microbial consortia to emergent functionalities and ultimately to high-value applications. Natural consortia found in Kombucha, water kefir, borș, and fermented elderflower drinks exemplify how metabolic cross-feeding, sequential substrate conversion, spatial organization within extracellular matrices, and ecological interactions generate emergent functionalities that surpass those of individual microorganisms.

Experimental evidence shows that these communities can simultaneously facilitate complex matrix biotransformation and generate high-value products. Kombucha fermentation enhances the accessibility of bee-collected pollen phytonutrients, while pollen, in turn, stimulates fermentation, due to the fructolactobacili that are introduced in the SCOBY. This platform also enables the *in situ* biosynthesis of biocompatible selenium nanoparticles with antioxidant properties. Bacterial cellulose produced during Kombucha fermentation is an additional valuable side-stream that can be converted into nanocellulose and further integrated with chitosan and fermentation-derived selenium nanoparticles to form multifunctional, cyto-compatible hydrogels. Similarly, water kefir supports both functional beverage production and dextran formation, with increasing antioxidant properties observed during fermentation. SCOBY consortia associated with traditional Romanian beverages have been shown to dissolve the complex matrix of agro-industrial side streams (such as pomace), facilitating further cascade processing while producing beverages with enhanced functionality.

Taken together, these findings support a transition from empirical fermentation practices to the rational reconstruction of bacteria-yeast communities, selected for complementary metabolic functions and engineered to control the conversion of complex renewable feedstocks. These consortia offer a promising foundation for integrated biorefineries that can produce functional foods, bioactive metabolites, biogenic nanoparticles, biopolymers, and advanced biomaterials, linking microbial ecology to biological pre-treatment in cascading biorefineries and circular value creation.

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Prof. Univ. dr. Rodica Mariana ION

National Institute for Research & Development in Chemistry and Petrochemistry - ICECHIM Bucharest

Valahia University of Târgoviște

Rodica-Mariana Ion is a distinguished Romanian professor and scientist specialized in analytical investigative techniques, nanomaterials and nanotechnologies in the conservation and restoration of cultural heritage objects and monuments.

She holds the position of Full Professor at Valahia University of Târgoviște, where she serves as the Director of the Council for Doctoral Academic Studies (CSUD) / Vice-Rector. Additionally, she is affiliated with the Polytechnic University of Timișoara, Architecture and Urban Planning Faculty, lecturing on material properties relevant to architecture and urbanism, including Cultural Heritage monuments and buildings.

Beyond academia, Professor Ion is member of Commission 7 of Materials Engineering and Science (CNATDCU), and member of European Commission DG SANTE, SCHEER-EU, Luxembourg. Throughout her academic and research career, she has authored and co-authored more than 375 scientific papers, and 32 books and book chapters, 63 national and international patents, with over 8,000 citations, placing her among the top researchers in nanoscience and nanotechnology in Romania. In the period 2020-2025, she is included in the Top 2% World scientists (Stanford University.

FROM DIAGNOSIS TO PRESERVATION: ADVANCED MATERIALS CHARACTERIZATION AND COMPATIBLE STRATEGIES FOR CULTURAL HERITAGE CONSERVATION

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Keywords: cultural heritage; heritage materials; historic monuments; materials/weathering characterization.

Introduction: Cultural heritage conservation requires, in addition to identifying degradation phenomena, an integrated understanding of original materials, historical technologies, environmental interactions, and the long-term compatibility of conservation treatments. This presentation brings together a series of investigations conducted on archaeological sites, historic buildings, stone monuments, mortars, plasters, ceramics, mosaics, and other heritage materials, linking material diagnostics with scientifically grounded conservation strategies.

Materials and Methods: A multi-analytical approach was employed—combining optical microscopy, FTIR and Raman spectroscopy, XRD, XRF, SEM–EDS, CLSM, μ-CT, colorimetry, morphological and surface analyses, as well as complementary physicochemical methods—to characterize material composition, microstructure, alteration mechanisms, and evidence of previous interventions [1].

Results: The proposed approach is illustrated through representative case studies from Romanian archaeological and architectural heritage, including Roman sites (Sucidava-Dunăreni, Sucidava Moesica, Sucidava-Celei, Micia-Rapoltu, Vartopu-Bumbesti-Jiu), as well as the Basarabi–Murfatlar archaeological complex, Banloc Castle, Nanu-Muscel House, Cioflea House, and other historic buildings and architectural ensembles. These investigations covered a wide range of heritage materials and degradation environments, demonstrating how analytical evidence can contribute to identifying ancient technologies, reconstructing material histories, assessing conservation status, and selecting compatible intervention strategies. Beyond diagnosis, the research has progressively focused on the development and evaluation of compatible mineral-based conservation materials, including calcium-phosphate and layered inorganic consolidants, designed to interact with historic substrates while preserving their physical, chemical, and aesthetic characteristics. Research into nanosized inorganic consolidants also illustrates the transition from laboratory material design to heritage conservation applications, Fig.1

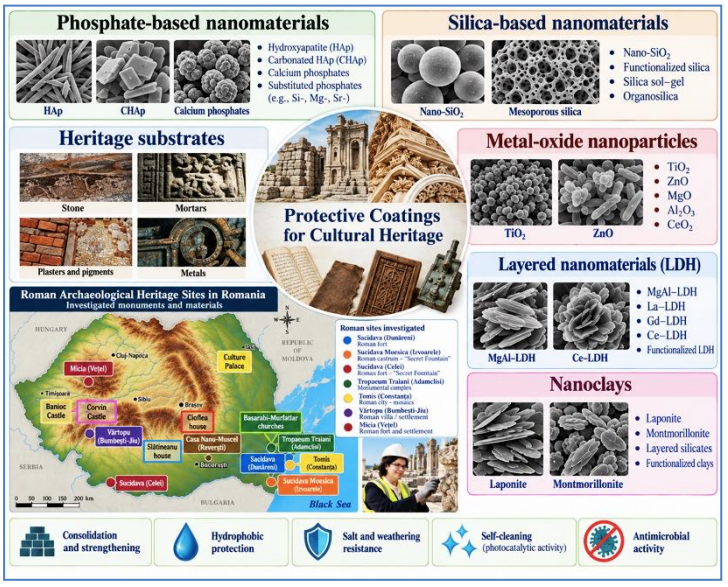


Fig.1. Nanotechnology coatings for different substrates

Conclusions: The results support an integrated diagnostic–mechanism–treatment–validation approach, in which conservation decisions are derived from both the material history and the monument's current condition. Although each monument presents a unique material biography and degradation context, a common scientific framework can link archaeometric investigation to conservation practice.

***Acknowledgements**: This work was supported by a grant from the Romanian Ministry of Education and Research, National Authority for Scientific Research (ANC), Nucleu project PN 23.06.02.01—InteGral, and by a grant of the Ministry of Education Research, CCCDI - UEFISCDI, project number PN-IV-P7-7.1-CI-2025-0190, within PNCDI IV.*

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Dr. Eng. Tanța-Verona Iordache is a Senior Researcher at the National Institute for Research and Development in Chemistry and Petrochemistry (ICECHIM Bucharest), where she leads the Advanced Polymer Materials and Polymer Recycling Research Group. She is also a Vice-President of the Romanian Chemical Society.

Her research expertise encompasses polymer chemistry, molecularly imprinted polymers, functional polymeric materials, and advanced molecular recognition systems. Her scientific interests include the design and development of selective recognition materials for analytical applications, environmental monitoring, and the detection of hazardous chemical and biological substances.

Her work combines polymer synthesis, materials characterization, and molecular imprinting strategies to develop innovative sensing and separation systems. She has contributed to research on molecularly imprinted nanogels, advanced polymeric interfaces, and materials with tailored recognition properties.

Through her scientific publications, research projects, and collaborative activities, Dr. Iordache has contributed to the advancement of functional polymer materials and their applications in analytical chemistry and environmental protection.

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HAZMAT DETECTION USING MOLECULARLY IMPRINTED POLYMERS

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Keywords: Molecularly imprinted polymers; HAZMAT; electrochemical sensors; screen-printed electrodes; molecular simulation;

Hazardous materials (HAZMAT) are substances that can harm people, property or the environment when released. They span a wide chemical range, from bacterial endotoxins that signal biological contamination to drugs of abuse and controlled substances relevant to forensic and security work. Their detection still relies mostly on laboratory techniques such as chromatography, mass spectrometry and immunoassays. These methods are accurate, but they are slow, expensive, and dependent on trained staff and fixed infrastructure. First responders, clinicians and control agencies therefore need sensors that are selective, robust, inexpensive and fast enough to be used at the point of need. This work presents molecularly imprinted polymers (MIPs) as the recognition element of such sensors. It traces how their design has moved from an incremental, experiment-led approach to one guided by molecular simulations.

MIPs are custom-made synthetic materials that act like artificial antibodies. They are obtained by polymerizing functional monomers and a cross-linker around a template molecule. Once the template is removed, the polymer retains cavities sculpted to fit that specific target in shape, size and arrangement of functional groups. Compared with biological receptors, MIPs combine high specificity and selectivity with extreme chemical and thermal durability, long shelf life and low production cost. When deposited on screen-printed carbon electrodes (SPCEs), they yield compact, disposable electrochemical sensors. Binding of the target in the imprinted cavities changes the current of a redox probe at the electrode surface, which is read by cyclic voltammetry (CV) and differential pulse voltammetry (DPV). In every study presented here, a non-imprinted polymer (NIP) was prepared identically but without the template and served as the control for specific recognition.

Across four targets, from a small synthetic drug precursor to a large bacterial endotoxin, MIP-based electrochemical sensors were designed to detect HAZMAT with clear discrimination from non-imprinted controls and from structurally related interferents. The classic incremental approach established the materials platform: ZnO nanoparticles, a carbon-paste layer and screen-printed electrodes. Molecular simulation then reduced the experimental burden of monomer selection and produced polymers whose selectivity was confirmed experimentally. Combining in silico design with simple, low-cost electrochemical read-out offers a general route to robust, portable and affordable sensors for hazardous substances. The next steps are validation in real samples, lower detection limits and integration into field-deployable devices.

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SECTION 1 - Multifunctional materials, nanocomposites, innovative technologies and cultural heritage preservation



THE DESIGN AND DEVELOPMENT OF SOME Cu(II) COMPLEXES OF FLUOROQUINOLONE DERIVATIVES WITH ACTIVITY AGAINST MULTIDRUG RESISTANT MICROORGANISMS

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Keywords: copper complexes of fluoroquinolones; drug design; molecular docking; antimicrobial agents.

Introduction: The resistance developed by bacteria threatens virtually all classes of antibacterial agents. The economic impact of antibiotic resistance is considerable and will continue to grow. In the medical practice, many antimicrobial agents with quinolone structure are used, some of them being regarded by leading pharmacologists as first rate drugs in human and veterinarian remedial therapy. Quinolones have a large activity spectrum and strong antibacterial activity [1,2]. They are characterized by their applicability in all localized infections. Lately, pharmacological studies have proved that quinolone derivatives have numerous other benefits: antiviral activity against herpes, antitumor properties, restraining neurovegetative diseases and ischemic infections and the stocking of foodstuffs (because of their bactericidal properties). The research for an ideal quinolone derivative continues worldwide [3-5].

Materials and methods: The paper presents original contributions in the drug design, molecular docking, synthesis and evaluation of antimicrobial activity of some Cu(II) complexes of fluoroquinolone derivatives. The obtained complexes have been analyzed by physicochemical methods. The antimicrobial activity has been evaluated against Gram-positive (*S. aureus, E. faecalis*) and Gram-negative (*K. pneumoniae, P. aeruginosa*) microorganisms.

Results: The study of antimicrobial activity revealed the ability of the essential bio complexes to inhibit the growth of microorganisms, especially Gram-positive bacteria (*S. aureus, E. faecalis*), but also Gram-negative ones (*K. pneumoniae, P. aeruginosa*).

Conclusions: An increased antibacterial activity was observed in Cu(II) Complexes of fluoroquinolone FPQ202.

***Acknowledgements**: This work was carried out through the NUCLEU Program within the National Research Development and Innovation Plan 2022-2027, carried out with the support of MCID, project no. PN 23-28 01 01*

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ENGINEERING BIOFOULING RESISTANT SURFACES BASED ON POLY(2-ISOPROPENYL-2-OXAZOLINE) HYDROGELS

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Keywords: poly(2-isopropenyl-2-oxazoline), hydrogels, biomaterials, antifouling

Introduction: Poly(2-isopropenyl-2-oxazoline) (PiPOx) hydrogels have been investigated as versatile biomaterials owing to their tunable physicochemical properties and very good interactive properties with cells.[1] While several aspects of their biomedical performance were explored, [2, 3] their interaction with proteins was not systematically investigated. This behaviour is particularly important for *in vivo* applications, since nonspecific protein adsorption is known to strongly influence the subsequent blood-material interactions. The present study evaluates the antifouling performance of PiPOx hydrogels together with their ability to limit platelet adhesion, providing an in -depth assessment of their behavior at the biointerface.

Materials and methods: Poly(2-isopropenyl-2-oxazoline) hydrogels were prepared through a one-pot aqueous cross-linking reaction carried out at 60 °C, using bio-based and non-toxic amino- or hydroxy-substituted dicarboxylic acids as cross-linking agents. For the DSC analysis, the hydrogels were swollen in both distilled water and PBS and were subjected to a cooling scan from 40°C to -40°C. Protein content was measured with widefield fluorescence microscopy using two concentrations of BSA and FBS. Platelet adhesion was observed with atomic force microscopy (AFM).

Results: DSC experiments revealed that the content of non-freezing water (NFW) depends on the type of cross-linker used, significantly increased with the presence of cationic groups. Cold crystallization was observed for some of the hydrogels, suggesting favorable blood-contacting properties. Widefield fluorescence microscopy revealed that protein adsorption takes place both on the surface and inside the hydrogels. At lower protein concentration the uptake was minimal, suggesting good antifouling properties. As expected, higher protein concentrations resulted in higher protein uptake, but even at concentrations comparable to *in vivo* levels, the hydrogels maintained their antifouling properties. The excellent hemocompatibility of PiPOx hydrogels is demonstrated by the low platelet adhesion, especially in the case of the sample containing aspartic acid.

Conclusions: DSC analysis of the swollen hydrogels showed that water predominantly existed in the non-freezing state, with a significantly increased content of NFW when swollen in PBS. Due to the intrinsic hydrophilicity of the polymer and the polarity of the 2-oxazoline side groups, PiPOx hydrogels demonstrated protein-repellent behavior, outperforming traditional PEG-based hydrogels. Furthermore, PiPOx hydrogels demonstrated excellent hemocompatibility, with almost no platelet adhesion despite measurable protein adsorption, surpassing the PEG standard. These findings highlight the potential of PiPOx hydrogels as implantable devices.[4]

***Acknowledgements**: The authors acknowledge the Romanian Ministry of Research, Innovation and Digitalization, CNCS/CCCDI – UEFISCDI, project number PN-IV-P6-6.1-CoEx-2024-0088 within PNCDI III, for the financial support.*

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CLINOPTILOLITE ENCAPSULATED WITH ESSENTIAL OIL

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Keywords: clinoptilolite; essential oil; encapsulation, controlled release

Introduction: Zeolites are considered promising matrices that encapsulates active ingredients such as essential oils in their channels and which are released slowly and in a controlled manner. Natural clinoptilolite, recognized for its antimicrobial properties, is widely used in biomedical, environmental and food applications, being the only zeolite registered in the EU as a medical product that can be used in oral treatment. Essential oils (EOs) are recognized for their antibacterial, antiviral, antifungal and antimicrobial properties, but they are often very unstable, insoluble in aqueous solutions, susceptible to oxidation, thermal degradation and/or rapid volatilization. Due to their poor stability and high costs, their protection is often necessary to guarantee their safety, efficacy, bioavailability, stability and quality [1, 2]. The present study aimed to evaluate the release of anise, cumin and fennel EOs from clinoptilolite modified with silver and zinc cations.

Materials and methods: Clinoptilolite activated with a 1:1 mixture of salts with Ag^{+} and Zn^{2+} cations (AgZnCRP), obtained through cation exchange reactions was dried for 24 h, at 160 °C and encapsulated with EOs extracted from plants (anise-AO, fennel-FO and cumin-CO), using a 1:10 mixture of essential oil and ethyl alcohol. Clinoptilolite encapsulated with EOs was denoted AgZnCRP-AO/FO/CO. The loading capacity and release behavior of the encapsulated EOs were analyzed by TGA, FTIR spectroscopy, and X-ray diffraction.

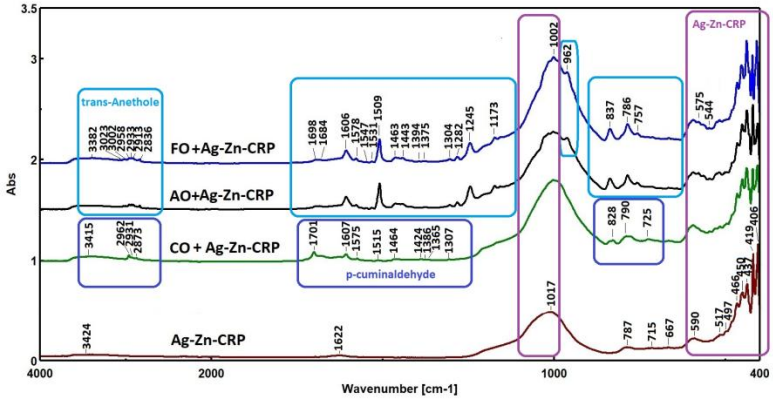


Figure 1. FTIR results for AgZnCRP modified with EOs

Results: TGA results, under isothermal conditions (2 h at 38 °C), revealed that by encapsulation in clinoptilolite the thermal stability of EOs improves, even substantially in the case of CO. The percentage of mass loss for AO/FO/CO encapsulated in AgZnCRP is 7.46%, 6.81% and 9.08% respectively, compared to 9.46%, 21.10% and 70.08%, respectively for AO, FO and CO as such. The release of EOs from AgZnCRP varies in the order FO<AO<CO. The loading degree of AgZnCRP with EOs is 22-23% and varies in the order AO>FO>CO. The results obtained by FTIR and XRD are evidence of the encapsulation of OE in the pores of AgZnCRP. The characteristic peaks of the active components of EOs are observed (Figure 1).

Conclusions: The thermal stability of EOs and their controlled and slower release capacity are increased by incorporation into the pores of clinoptilolite. The degree of loading of clinoptilolite with EOs depends on their thermal stability. The lower the volatility of EOs (better thermal stability), the better the encapsulation capacity.

Acknowledgements: *This work was supported by grant of the Ministry of Research, Innovation and Digitalization, CNCS/CCCDI-UEFISCDI, project number ERANET-M-3-SMARTCAP-1, financing contract 73/2024, within PNCDI IV.*

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OPTIMISATION OF ELECTROCHEMICAL SENSORS BASED ELECTRODEPOSITED DIAZONIUM COMPOUNDS FOR HEAVY METALS DETECTION

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Keywords: electrochemical surface modification, diazonium salts, heavy metals

Introduction:
The contamination by heavy metals, even at low concentrations, has a negative impact on human health and environment. While various techniques such atomic spectroscopy provide high performances in heavy metals analysis, there is still a need for simpler, more affordable detection methods tailored for specific samples. The electrochemical techniques represent an attractive alternative due to their good sensitivity, operational simplicity, shorter analysis time, lower-cost equipment and minimum sample pretreatment. Among the numerous for electrode functionalization strategies, the strong bonds created using diazonium moieties are very attractive for the development of modified electrodes with different usages such as enzyme immobilization or heavy metal detection. The reagents used for electrode surface modification are bifunctional compounds with one moiety for linking and the other for chelation: 4-nitrophenyl isothiocyanate [1] and 4-aminothiophenol [2].

Materials and methods
Since the diazonium groups are unstable, they are created *in situ* just before electrode modification from the corresponding aromatic amine with $NaNO_2$ and HCl. The cleaned glassy carbon electrode surface was modified with 4-aminothiophenol in presence of DPPH by chronopotentiometry at constant current of in solution freshly prepared in water: acetonitrile 1:1 and cooled in ice. For the compound that contain a nitro a preliminary step was necessary to electrochemically reduce this moiety to amino by chronoamperometry at -0.6 V and followed by the electrografting by chronopotentiometry at -0.025 mA of the diazonium groups that are produced in situ from the amino groups in presence of HNO_2.

Results
The electrodes modified with 4-nitrophenyl isothiocyanate were used for the determination of Pb(II) and Fe(II) by DPV. The calibration graph for Pb(II) has a linear range: 2.5 - 200 µg L-1 Pb(II), equation Ip=1.59 C + 20.057, R2 = 0.9929 and the detection limit is 1.2 µg L^{-1}. In the case of Fe(II) ions, the peak currents are lower and the calibration graph is linear in the range 2.5 - 100 µg L-1 Fe(II), equation Ip = 0.9663 C + 6.7762, R2 = 0.9952 with the detection limits being 2.0 µg L^{-1}.
The electrodes modified with 4-aminothiophenol were used for the determination of Pb(II) and for Cd(II) also by DPV. For Pb(II) a linear dependence was obtained in the concentration range of 2.5 - 400 mg L^{-1} and the detection limit of 1.2 mg L^{-1}. In the case of Cd(II) the calibration line was obtained in the range of 2.5–400 µg L^{-1}, with a detection limit of 1.5 mg L^{-1}

Conclusions: The diazonium based methods the electrode surface produces stable thin organic layers with minimal surface passivation. In the case on nitro starting modifier the modified electrodes were obtained without the use of a radical quencher such as DPPH, which is typically required for amino-containing modifiers.

Acknowledgements*:* This work was performed with the support of MRID through the Core Program within the National Research, Development and Innovation Plan 2022–2027 project no. 23020101(SIA-PRO), contract no 7N/2022, project PNRR-III-C9-2022 – I5 cod 18/16.11.2022 (RESPONSE) and PN-IV-P6-6.1-CoEx-2024-0025.

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CARBOXYMETHYLATION OF CHITOSAN FOR 3D-PRINTED MULTIFUNCTIONAL HYDROGELS WITH ENHANCED BIOLOGICAL ACTIVITY

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Keywords: carboxymethyl chitosan, 3D printed multifunctional hydrogels

Introduction: Carboxymethyl chitosan (CMCS) is a water-soluble derivative of chitosan that exhibits several beneficial biological properties, including biocompatibility, biodegradability and antimicrobial activity. Considering these characteristics, CMCS is widely used in many new types of wound dressings [1]. Modern wound care requires materials that promote healing while controlling inflammation and microbial growth. Multifunctional hydrogels combining antibacterial and anti-inflammatory properties are promising wound dressing platforms [2]. In this study, a multifunctional 3D-printed CMCS/Alginate hydrogel containing indomethacin-loaded PLGA nanoparticles (INM PLGA Nps) and nitrofurantoin (NFI) was developed as a potential platform for infected wound therapy.

Materials and methods: CMCS was synthesized from chitosan via carboxymethylation. The CMCS/Alg formulation was optimized for 3D printing using $CaCl_2$ as a crosslinking agent. INM PLGA Nps and NFI were subsequently incorporated to obtain the final biomaterial. The materials were characterized by DLS, FTIR, and SEM to determine their hydrodynamic properties, chemical structure, and morphology. Encapsulation efficiency and drug release profiles were also evaluated. *In vitro* biological evaluation included MTT and LDH assays, alongside anti-inflammatory and antibacterial activity assessments.

Results: The carboxymethylation was confirmed by ^{1}H NMR and FTIR analyses. DLS showed nanoparticles below 200 nm with a relatively uniform size distribution, while FTIR confirmed their chemical structure. The formulation with highest drug concentration was selected based on its encapsulation efficiency. Drug release was subsequently evaluated, showing a sustained release profile. The 3D printed scaffolds exhibited slightly rounded pore edges while maintaining their overall structure. The addition of NFI and nanoparticles improved print fidelity, with the printed structures better preserving the designed geometry. SEM revealed a porous microstructure with interconnected pores of varying sizes. The nanoparticles incorporated into the hydrogel exhibited slower drug release compared with free nanoparticles, in contrast, NFI directly dispersed within the hydrogel showed faster release, as it was readily available within the matrix. MTT results showed high cell viability across all formulations, indicating good biocompatibility. Low LDH levels confirmed minimal cytotoxicity, with small differences between formulations compared with the control. The TGF-β assay indicated a moderate anti-inflammatory effect. The formulations exhibited strong antibacterial activity against both tested strains.

Conclusions: In conclusion, 3D-printed multifunctional hydrogels with suitable properties for wound management were developed and characterized. Nanoparticles and active compounds were successfully incorporated, while all formulations showed good biocompatibility. Overall, the findings demonstrate the potential of this multifunctional 3D-printed hydrogel as a promising wound dressing for controlling infection while supporting tissue regeneration.

Acknowledgements:
This work was funded by a grant of Ministry of Research and Innovation, UEFISCDI, project number PN-IV-P8-8.1-PRE-HE-ORG-2023-0054 (contract no. 17 PHE / 2023) within PNCDI IV and PN 23.06 Core Program—ChemNewDeal within the National Plan for Research, Development and Innovation 2022–2027, developed with the support of the Ministry of Research, Innovation, and Digitization, project no. PN 23.06.02.01 (InteGral).

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COMPARATIVE IN VITRO CYTOTOXICITY OF FREE AND PH-SENSITIVE LIPOSOMAL DOXORUBICIN IN MCF-7 AND MDA-MB-231 BREAST CANCER CELLS

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Keywords: pH-sensitive liposomes; doxorubicin; breast cancer; MCF-7; MDA-MB-231

Introduction: pH-sensitive liposomes represent a promising approach for modulating doxorubicin (DOX) delivery in breast cancer aimed to decrease its the systemic toxic effects [1]. The response of such liposomes to acidic environments can facilitate the release of encapsulated drugs and provides a rationale for stimulus-responsive anticancer delivery [2]. This study compares the *in vitro* cytotoxic effects of free DOX and pH-sensitive DOX-loaded liposomes in MCF-7 and MDA-MB-231 breast cancer cells.

Materials and methods: Soy PC, DOPE, and CHEMS were combined at a 25:45:30 molar ratio to obtain pH-sensitive liposomes through continuous microfluidic method using an Elveflow system. Vesicle formation occurred by rapid mixing of the organic and aqueous streams at a total flow rate of 1.4 mL/min and an organic-to-aqueous flow-rate ratio of 1:2.5. Purification of the liposomes was afterwards performed by dialysis. The obtained sample is denoted as Lip-S1-pH-DOX. Hydrodynamic size was assessed by dynamic light scattering using an Amerigo Particle Size and Zeta Potential Analyzer from Cordouan. Prior to cell cultures testing, the sample was evaluated for the capacity to release drug as response to the pH value at 7.4, 6,4 and 5.5 by the dialysis method at constant volume. Then, MCF-7 and MDA-MB-231 cell lines were treated with free DOX or Lip-S1-pH+DOX (0.25 - 8 µg/mL) for 24 and 72 h, and viability was measured by the MTT assay. Data are presented as mean ± SD. Cell viability is expressed as a percentage of the untreated control.

Results: Lip-S1-pH+DOX with a mean hydrodynamic diameter of approximately 260 nm and a PDI of 0.125, indicating a very good size homogeneity of the sample, was prepared for DOX delivery to breast cancer. Due to the reproducibility of the size, flow-controlled microfluidic processing was used for preparation of the liposomal formulation of DOX [3]. The amount of DOX loaded into liposomes represent ~5% of the fomulation. The *in vitro* release experiments clearly showed the influence of the pH on the phospholids of liposomes, which promoted destabilization of the membrane at lower pH value. This process is supported by increased release from ~20% at pH 7.4 to ~40% at pH 5.5 after 72 h of testing. Then, the two breast cancer cell lines have been treated with free and Lip-S1-pH+DOX. The results showed that at physicological pH, cell viability of both lines was reduced in a concentration and exposure-time-dependent manner. Yet, the effect of the liposomal DOX was weaker as compared with free DOX under these experimental conditions (**Figure 1**).

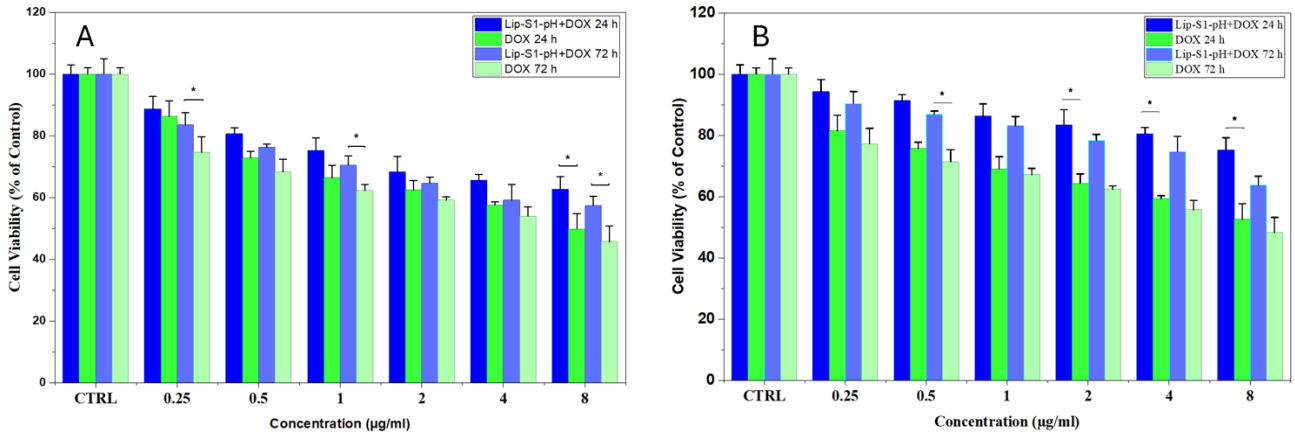


Figure 1: *In vitro* cytotoxicity of Lip-S1-pH-DOX) and free DOX in MDA-MB-231 (A) and MCF-7 (B) breast cancer cells after 24 and 72 h of treatment. *p < 0.05.

At 8 µg/mL after 72 h, free DOX reduced cell viability to 45.73% in MCF-7 cells and 48.24% in MDA-MB-231 cells, whereas Lip-S1-pH-DOX resulted in viabilities of 57.45% and 63.71%, respectively. The findings show a good biocompatibility of the liposomes, on the one hand, while on the other hand, the release of a lower concentration of DOX after entering the cells, which are in well agreement with the literature [4,5].

Conclusions: Liposomal formulation of DOX was successfully obtained by microfluidic approach and passive loading. The drug, which represents ~5% of the sample, was released from the pH-sensitive liposomes depending on the pH of the release medium, showing higher release amount at endosomal simulated pH. Yet, the free DOX and liposomal DOX exhibited similar effects on cells due to the lower amount of DOX released at the physiological pH.

***Acknowledgements**: This work was supported by the H2020 ERA-Chair project, Grant Agreement No. 952390/2020, and PN-IV-PCB-RO-MD-2024-0363 funded by UEFISCDI.*

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BIOLOGICAL EVALUATION OF PH-RESPONSIVE DOXORUBICIN-LOADED LIPOSOMES IN A172 AND U118 GLIOBLASTOMA CELLS

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Keywords: pH-responsive liposomes; doxorubicin; glioblastoma; A172; U118

Introduction: Glioblastoma (GBM) remains a challenging malignancy, highlighting the need for improved anticancer drug delivery strategies. Liposomal nanocarriers have attracted interest in GBM therapy their unique ability to cross the blood-brain barrier (BBB) and deliver drugs directly to tumor sites while minimizing systemic toxicity [1,2]. In this context, pH-responsive liposomes represent a promising strategy because they additionally can promote drug release under acidic conditions [3]. Herein, doxorubicin (DOX)-loaded pH-triggered liposomes have been developed and evaluated for the *in vitro* cytotoxic activity in A172 and U118 GBM cells.

Materials and methods: Using an Elveflow system and a continuous microfluidic method, soy PC, DOPE, and CHEMS were mixed at a 25:45:30 molar ratio to prepare the pH-sensitive liposomes. Rapid mixing of the organic and aqueous solutions at a total flow rate of 1.4 mL/min and an organic-to-aqueous flow-rate ratio of 1:2.5 led to vesicle formation while encapsulating DOX. The unloaded DOX was removed by dialysis. An Amerigo Particle Size and Zeta Potential Analyzer from Cordouan was used to measure hydrodynamic size through dynamic light scattering. The sample's ability to release drug in response to pH values of 7.4, 6.4, and 5.5 was assessed using the dialysis method at constant volume. The viability of A172 and U118 cell lines was then assessed using the CellTiter-Blue assay after they were exposed to either liposomal or free DOX (0.25 - 8 µg/mL) for 24 and 72 h. The percentage of the untreated control was used to express cell viability. Results are expressed as percentages from the control wells' cell viability (as negative control; *i.e.* wells containing only cultured cells without addition of the tested samples).

Results: For DOX delivery to GBM, liposomal DOX was prepared with a mean hydrodynamic diameter of cca 260 nm and a PDI of 0.125, indicating a very narrow size distribution of the sample. The liposomal formulation of DOX was prepared using flow-controlled microfluidic method to ensure homogeneity of the size [4]. About 5% of the drug was loaded in the liposomal formulation of DOX by using passive approach. The *in vitro* release experiments performed using the dialysis method demonstrated pH-dependent DOX release, with a higher amount of DOX released under acidic conditions after 72 h of test. Next, both free and liposomal DOX were administered to the two GBM cell lines.

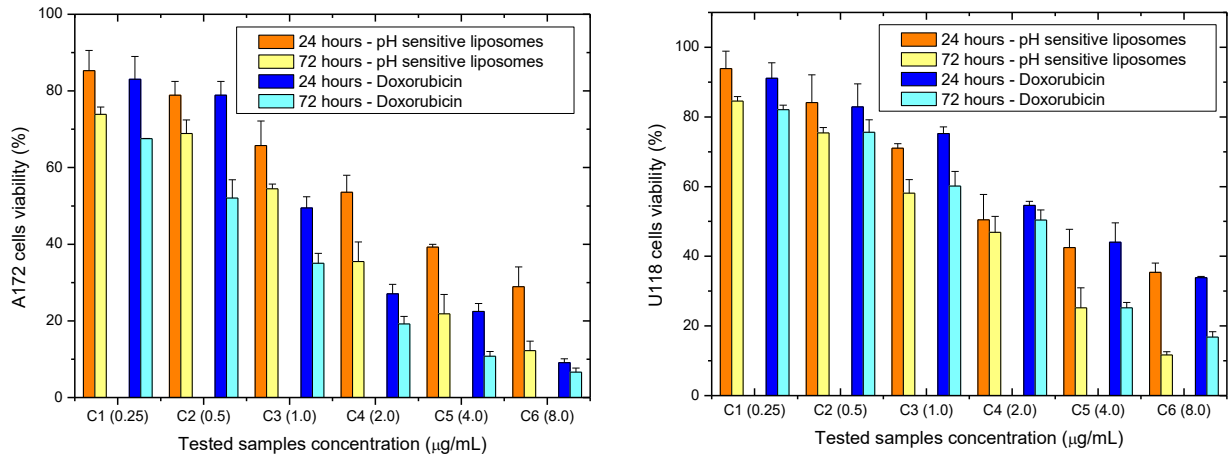


Figure 1. *In vitro* cytotoxicity of pH-sensitive liposomes versus Doxorubicin on A172 and U118 glioblastoma cells at different concentrations.

The results illustrated in **Figure 1** show that the viability of both cell lines decreased in a concentration and exposure-time-dependent manner. However, the normal physiological pH of the cells favored a similar effect of liposomal DOX and free DOX, which correlates well with previously reported results in the literature on pH-triggered liposomal DOX formulation [5,6]. After 72 h of treatment, the IC_{50} values for both A172 and U118 cells were within the range of 1.0 - 2.0 μg/mL.

Conclusions: Liposomal formulation of DOX was successfully obtained by microfluidic approach and passive loading. The drug, which represents ~5% of the sample, was released from the pH-sensitive liposomes depending on the pH of the release medium, showing higher release amount at endosomal simulated pH. Yet, the free DOX and liposomal DOX exhibited similar effects on cells due to the lower amount of DOX released at the physiological pH.

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BREATHING ROOM FOR SKIN CELLS: MAGNESIUM-DOPED BIOACTIVE GLASS COUNTERACTS HYPOXIC STRESS IN HUMAN DERMAL FIBROBLASTS

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Keywords: bioactive glass, magnesium, hypoxia, fibroblasts, tissue engineering

Introduction: Bioactive glass nanoparticles are promising candidates for biomedical applications, but their biological performance is almost exclusively tested under normoxic conditions (21% O_2). This standard practice overlooks hypoxia, a relevant reduction in tissue oxygen tension that naturally occurs in damaged sites like bone defects and chronic wounds [1]. Addressing this gap between conventional *in vitro* testing and the actual oxygen microenvironment of injuried tissue is essential for predicting biomaterial performance *in vivo*.

Materials and methods: Mesoporous bioactive glass nanoparticles (MBGNs) and magnesium-doped ones (Mg-MBGNs) were synthesized via a sol-gel route [2]. Their biological performance was observed under normoxic (21% O_2) and hypoxic (1% O_2) conditions using normal human dermal fibroblasts. Ionic extracts at different concentrations were used to evaluate the proliferative activity (WST-8 assay) and structural organization (fluorescence microscopy).

Results: SEM and XRD characterization confirmed the synthesis of spherical and amorphous nanoparticles. *In vitro* data revealed that cellular responses depend on both the released ion profile and oxygen tension. Under hypoxia, fibroblasts exposed to MBGN ionic solutions showed metabolic dysregulation, whereas cells treated with Mg-MBGN ionic solutions maintained metabolic activity closer to normoxic levels.

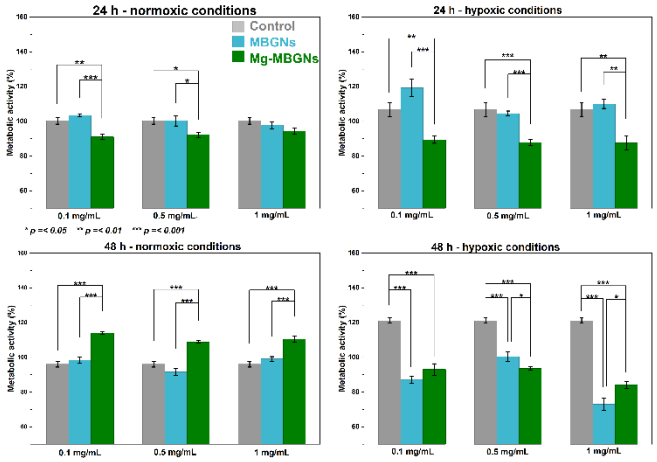


Figure 1. WST-8 activity of NHDF exposed to MBGNs and Mg-MBGNs ionic solutions under normoxic and hypoxic conditions

Conclusions: This work establishes that Mg^{2+} counteracts hypoxic stress in human fibroblasts. The effect is attributed to magnesium's role in supporting enzymatic reactions and sustaining overall cellular function during oxygen limitation [3]. These findings demonstrate that ionic solutions from Mg-MBGNs promote cellular resilience, reinforcing the need to test these platforms under physiologically relevant oxygen parameters.

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POLYSACCHARIDE-CLAY HYBRID HYDROGELS FOR THE SUSTAINABLE REMOVAL OF ANTIBIOTICS RESIDUES FROM CONTAMINATED WATERS

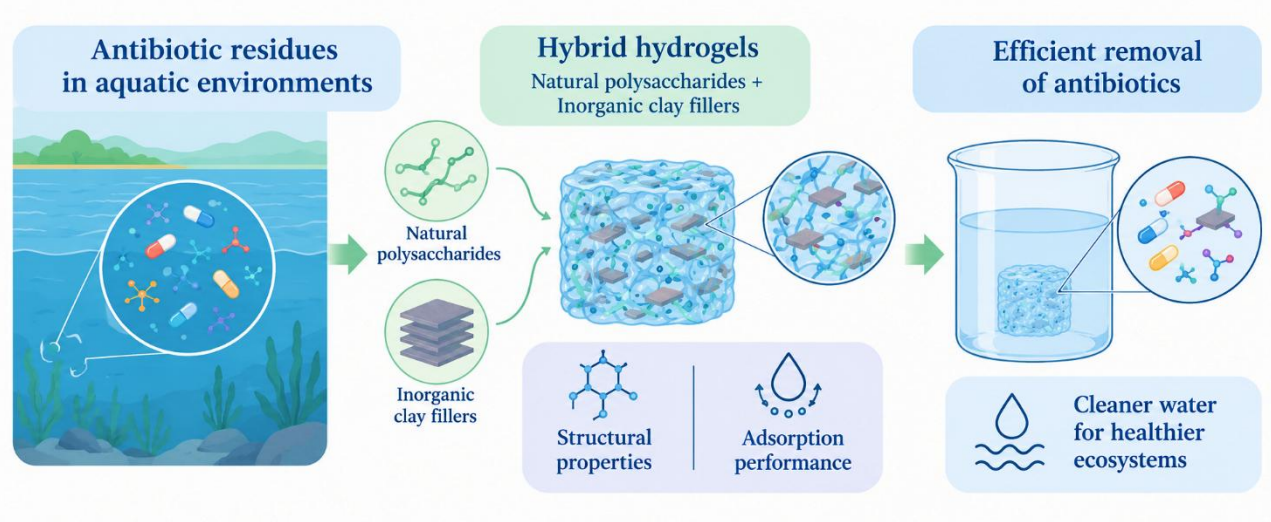
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Keywords: innovative hydrogel; antibiotic removal; water decontamination; green synthesis

Introduction: The presence of antibiotic residues in aquatic environments highlights the need for effective materials for water remediation[1]. This study investigates hybrid hydrogels based on natural polysaccharides and inorganic clay fillers, focusing on their structural properties and adsorption performance toward selected antibiotics.



Materials and methods: Chitosan and alginate were used to develop stable three-dimensional hydrogel networks with high water-retention capacity and tunable porosity. Montmorillonite and Laponite were incorporated as inorganic clay fillers to modify the hydrogel structure and functional properties[2]. Different degrees of crosslinking and functionalization strategies were investigated. Physicochemical characterization and adsorption experiments were performed using tetracycline and ciprofloxacin as model antibiotics. Adsorption mechanisms were evaluated considering electrostatic interactions and hydrogen bonding between the antibiotics and the polymer–clay network.

Results: The hybrid hydrogels exhibited water-retention capacities above 90%, with enhanced mechanical stability, specific surface area, and availability of active adsorption sites following clay incorporation. Adsorption capacities ranged from 100 to 450 mg/g for tetracycline and from 80 to 250 mg/g for ciprofloxacin. Removal efficiencies reached up to 90% under optimized pH and adsorbent dosage conditions. Material performance varied with the degree of crosslinking and functionalization strategy. Adsorption kinetics were well described by a pseudo-second-order model. Adsorption kinetics were described by a pseudo-second-order model, providing a useful representation of the uptake behaviour.

Conclusion: These findings highlight the potential of polysaccharide–clay hybrid hydrogels as adaptable adsorbent matrices for antibiotic removal from contaminated water. The combination of biopolymer networks and inorganic fillers offers opportunities to tailor material structure and adsorption performance for environmental remediation applications.

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BORON CARBON OXYNITRIDE LOADED WITH DANDELION BIOACTIVE COMPOUNDS FOR CONTROLLED ANTIOXIDANT RELEASE

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Keywords: BCNO nanoparticles, Taraxacum officinale, antioxidant activity, nanostructured carriers

Introduction: Two-dimensional nanostructures, particularly boron nitride (BN) and its derivative BCNO, a boron-doped carbon-oxide system, are increasingly explored as biocompatible drug-delivery matrices due to their chemical stability and tunable surface chemistry [1]. Surface functionalization further enhances BCNO biocompatibility and cellular uptake, while its tunable luminescence enables imaging-based monitoring [2]. Boron-containing nanostructures are also promising multi-functional agents for BNCT [2,3]. In this context, BCNO nanoparticles were loaded with antioxidant polyphenols and chlorophylls from dandelion (*Taraxacum officinale*) for controlled release applications.

Materials and methods: BCNO nanoparticles were synthesized at two different temperatures, 500 °C and 1000 °C, and subsequently evaluated as nanostructured carriers for dandelion-derived polyphenolic and chlorophyll compounds. The physicochemical properties of the pristine and loaded nanoparticles were investigated using Fourier-transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), X-ray diffraction (XRD), Brunauer–Emmett–Teller (BET) surface-area analysis, UV–Vis diffuse reflectance spectroscopy, and scanning electron microscopy (SEM). The loading process was assessed based on the structural, thermal, optical, and morphological changes induced by adsorption. In vitro release experiments were performed to investigate the release behavior of the loaded bioactive compounds, while antioxidant assays were employed to evaluate the preservation of antioxidant activity following incorporation into the BCNO matrix.

Results: FTIR analysis provided evidence of the adsorption of polyphenolic and chlorophyll compounds onto the BCNO surface through characteristic changes in the vibrational bands associated with the organic constituents and the nanostructured matrix. Thermal analysis and XRD measurements revealed distinct temperature-dependent differences in the thermal stability and structural characteristics of the nanoparticles synthesized at 500 °C and 1000 °C. BET analysis indicated that the specific surface area and pore characteristics influenced the loading capacity of the BCNO nanoparticles. Changes observed in the UV–Vis diffuse reflectance spectra further supported the incorporation of the bioactive compounds, whereas SEM analysis revealed the nanostructured morphology and their distribution at the nanoparticle surface. Release studies demonstrated a sustained release profile for both polyphenolic and chlorophyll compounds, indicating the potential of BCNO nanoparticles to modulate the availability of the incorporated bioactive molecules. Importantly, antioxidant assays showed that the antioxidant activity was retained following loading, supporting the functional preservation of the dandelion-derived compounds within the nanostructured system.

Conclusions: Overall, the findings demonstrate that BCNO nanoparticles synthesized under different thermal conditions can serve as promising nanostructured carriers for natural bioactive compounds obtained from *Taraxacum officinale*. The observed relationship between synthesis temperature, physicochemical characteristics, loading behavior, and release performance highlights the importance of controlling the structural properties of BCNO nanoparticles for the development of efficient delivery systems. The sustained release behavior, together with the preservation of antioxidant activity, supports the potential application of these hybrid BCNO–phytochemical systems in the development of advanced nutraceutical and biomedical formulations.

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THREE-DIMENSIONAL MACROPOROUS COMPOSITE FOR DYE RETENTION FROM WASTEWATER

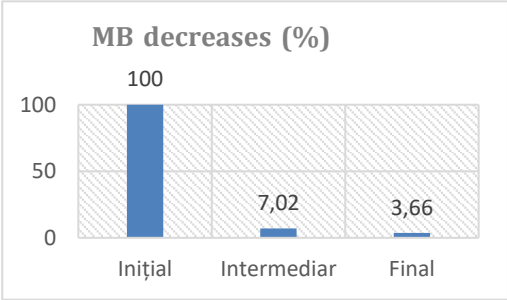
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Keywords: circular economy, reused polystyrene, filters.

Introduction: The contamination of industrial wastewater with synthetic dyes represents a significant environmental concern, requiring the development of efficient, low-cost and sustainable treatment technologies. This study proposes a porous structural filter obtained through the valorization of expanded polystyrene waste and bio-mineral adsorbents. The concept combines waste recycling with the development of a solid material characterized by interconnected open porosity, designed to facilitate water flow while providing an effective retention capacity for dissolved dyes. The composite falls within the fields of the circular bioeconomy, industrial effluent treatment, and the eco-friendly management of solid waste (waste polystyrene and biomass). Specifically, the invention concerns the production of a solid structural filter with controlled open porosity, designed to adsorb industrial dyes from wastewater using a low-energy, low-emission cold processing method; the filter element is created by cold-processing waste polystyrene into a solid matrix featuring open pores and interconnected channels, within which bio-mineral adsorption agents are stably embedded, thereby ensuring optimal hydraulic flow and high contaminant retention efficiency without the use of thermal energy.

Materials and methods: The filter material is composed of waste expanded polystyrene, diatomite with a particle; dry residue from vegetable biofuel production with a particle [1,2]. The filtering composite was produced through a cold-processing route, without thermal treatment, thereby reducing energy consumption and associated emissions. The resulting three-dimensional cellular material exhibited interconnected pores and channels, enabling water circulation and effective contact between dissolved contaminants and the immobilized adsorbent phases [3]. The retention performance was evaluated using methylene blue as a model dye, with dye removal monitored by UV–Vis spectrophotometry.

Results: The developed composite exhibited a stable three-dimensional porous architecture suitable for the passage of aqueous solutions and interaction with the incorporated adsorbent phases. UV–Vis measurements showed a pronounced decrease in methylene blue absorbance from an initial value of 2.929 to 0.2057 after the intermediate filtration stage and to 0.1073 after the final treatment. Based on the initial and final absorbance values, an overall dye retention efficiency of 96.34% was achieved. These results demonstrate the effective removal of methylene blue from the aqueous phase and indicate that the interconnected porous structure provides efficient contact between the contaminated solution and the bio-mineral adsorbent components.



Conclusions. The developed porous composite integrates waste valorization and wastewater treatment within a single multifunctional material, combining the recycling of expanded polystyrene, the reuse of residual biomass and the incorporation of diatomite as a mineral adsorbent. The 96.34% removal efficiency for methylene blue demonstrates the potential of this composite as a low-energy and sustainable filtering material for the treatment of dye-contaminated wastewater.

Conclusions: A composition for producing a porous cellular filter designed to retain dyes from wastewater demonstrates an overall retention efficiency of over 96%.

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MOLECULAR RECOGNITION MEETS ELECTROCHEMISTRY: NANOMIP/MOF INTERFACES FOR COCAINE DETECTION

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Keywords: cocaine, MIPs, MOFs, screen-printed electrodes

Introduction: Cocaine is one of the most widely used and trafficked illicit drugs worldwide. It is a powerful and highly addictive central nervous system stimulant derived from the leaves of the South American coca plant [1]. Current cocaine detection approaches, including sniffer dogs and conventional forensic analyses, may present several limitations, such as operator dependence, high costs, time-consuming procedures, fatigue-related variability, and the need for sophisticated instrumentation. These drawbacks highlight the need for rapid, accurate, sensitive, and cost-effective detection methods [2]. In this manner, electrochemical sensors incorporating molecularly imprinted polymers (MIPs) represent a viable option for selective cocaine detection. This study reports the development of a simple and cost-effective electrochemical sensing platform based on screen-printed carbon electrodes (SPCEs) modified with MIP nanoparticles (nanoMIPs), gold nanoparticles (AuNPs), and metal–organic frameworks (MOFs) for cocaine detection in aqueous media.

Materials and methods: Pre-synthesized nanoMIPs obtained by precipitation polymerization using cocaine hydrochloride as the template molecule were employed for the preparation of the electroactive paste formulations [3]. The nanoMIPs were incorporated into a polyethylene glycol-based sol–gel matrix containing an aqueous hydrochloric acid solution, tetraethyl orthosilicate, MOFs, AuNPs, commercial carbon paste, and Aquivion as binder. After ultrasonication, the formulations were drop-cast onto SPCEs to obtain the final MIP-based sensors. NIP control sensors were prepared following the same procedure using nanoNIPs synthesized without the cocaine template.

Results: The developed electroactive formulations and modified electrodes were investigated by structural, morphological, and electrochemical characterization. SEM–EDS was employed to evaluate the surface morphology and elemental composition of the sensing interfaces. Surface roughness parameters were estimated from SEM images using Gwyddion software. CV and differential DPV were used to investigate the electrochemical behavior of the modified electrodes and to determine relevant analytical parameters, including the limit of detection (LOD) and electrochemically active surface area (EASA), under physiological pH conditions (pH 7.4). The selectivity of the developed SPCE-based sensors toward cocaine was further investigated in the presence of other illicit drugs, including methamphetamine.

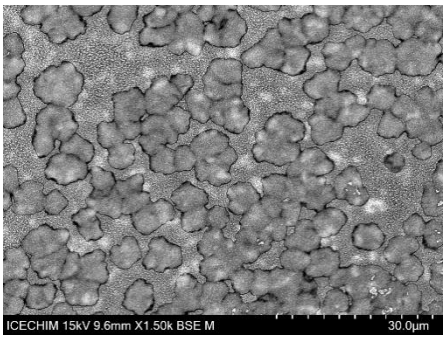


Figure 1. SEM Analysis of nanoMIP/MOF-modified SPCE

Conclusions: Overall, the developed nanoMIP/MOF-modified SPCE sensing platforms demonstrated promising sensitivity, stability, and selectivity toward cocaine detection. Future studies will focus on evaluating their analytical performance in more complex biological matrices, particularly saliva.

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VALORIZATION OF WOOD SAWDUST THROUGH OBTAINING BIO-HYBRID MATERIALS: A COMPARATIVE STUDY OF LIGNIN–ZnO PROPERTIES

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Keywords: wood waste valorization; alkaline delignification; lignin–ZnO hybrids; bio-based materials

Introduction: Sawdust generated in large amounts by the wood-processing industry is still poorly exploited, although it is an inexpensive source of lignin, the most abundant natural aromatic polymer. Owing to its phenolic framework, numerous hydroxyl groups, and radical-scavenging capacity, lignin is increasingly considered a building block for value-added functional materials [1,2], including as a green support for the nucleation and stabilization of ZnO nanoparticles, leading to hybrids with improved performance [3,4]. The objective of this work was to convert sawdust from different wood species into bio-hybrid materials and to compare the resulting hybrids in terms of structure and properties.

Materials and methods: Lignin was separated from different sawdust types by alkaline (NaOH) delignification under controlled conditions (alkali concentration, temperature, and duration), followed by acid precipitation, washing, and drying, so that the yield and purity obtained for each wood species could be compared. ZnO nanoparticles were then deposited on the lignin surface by an in-situ precipitation–functionalization approach, with the phenolic and aliphatic hydroxyl groups of the macromolecule acting as nucleation, anchoring, and stabilization sites. The samples were characterized by FTIR, XRD, SEM, and UV-Vis spectroscopy.

Results: FTIR spectra verified the effectiveness of delignification and revealed Zn–O vibrations and Zn–O–lignin interactions in the hybrids. XRD established the hexagonal wurtzite phase of the deposited ZnO, allowed estimation of the average crystallite size with the Scherrer equation, and showed modifications of the amorphous halo of lignin. SEM images provided information on particle morphology and surface features, as well as on the dispersion of ZnO and the degree of coverage of the lignin surface. UV-Vis spectra were used to derive the optical response and band-gap values of the hybrids, key parameters for UV-blocking and photocatalytic applications.

Conclusions: Correlating the sawdust origin with the soda lignin composition and the efficiency of ZnO deposition provided structure–property relationships that guide the selection of the most suitable lignin source for hybrid nanomaterials with multifunctional purposes. The approach converts an abundant industrial by-product into low-cost, bio-based composites, in line with circular-economy principles.

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HYBRID MAGNETIC MATERIALS INCORPORATING ZIRCONIUM FOR ENHANCED HEAVY METAL REMOVAL

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Keywords: magnetite, silane moieties, zirconium, heavy metals, water purification

Introduction: Heavy metals, including arsenic (As), lead (Pb), and chromium (Cr), present substantial risks to human health and ecosystems. Their persistence in water is particularly concerning because they are non-biodegradable and require removal through methods such as adsorption [1]. Magnetic nanoparticles, such as magnetite, enhance heavy-metal adsorption [2]. However, magnetite nanoparticles tend to aggregate reducing their stability and effectiveness and requiring surface modification to improve performance [3]. Incorporating zirconium oxides with magnetite enables a more efficient removal of a broad spectrum of contaminants, including heavy metals [4].

Materials and methods: Building on the existing literature, hybrid materials comprising both magnetite and zirconium (SGMP-Zr) were developed for heavy-metal removal. To improve stability, magnetite particles (MP) were first coated with a silane layer using a mixture of 3-aminopropyltriethoxysilane (APTES) and tetraethylorthosilicate (TEOS) to form SGMP, which was then modified with Zr to yield SGMP-Zr. The samples were characterized for chemical composition and crystal structure using X-ray diffraction (XRD), porosity (using Brunauer–Emmett–Teller (BET) analysis), and water decontamination performance, including whether the adsorbent could be regenerated.

Results: All three XRD spectra display the characteristic peak of magnetite. After coating with the silane layer, a characteristic peak of silane amorphous silica also appears for SGMP and SGMP-Zr.

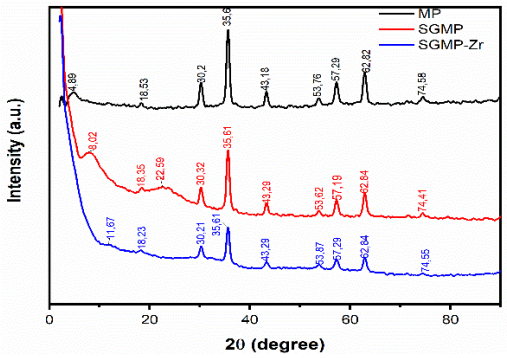


Figure 1. XRD patterns for MP, SGMP, and SGMP-Zr

After zirconium modification, the organosilane network's structural integrity is preserved. BET results show that silane modification significantly decreases both specific surface area and pore surface area, whereas both parameters increase after zirconium modification. All three samples promoted the removal of the three heavy metals of interest from both synthetic and real water. Performance varies by metal.

Conclusions: The modern characterization techniques confirm that both modification stages were successful. Due to the variability in decontamination performance based on the type of heavy metal and the sample matrix, optimal conditions can be determined for each specific metal. When switching to real water, decontamination efficiency decreases compared with synthetic water because the matrix is more complex. The materials can promote a second decontamination, even though the purification performance is slight lower.

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ULTRASOUND-ASSISTED TECHNOLOGY FOR CHEMICAL WARFARE AGENTS' SIMULANTS DESTRUCTION

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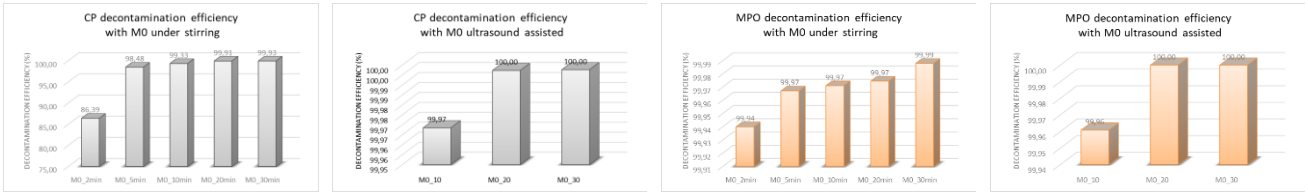
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Keywords: ultrasound-assisted technology; chemical warfare agents; organophosphorus pesticides

Introduction: Conventional chemical warfare agent (CWA) decontamination processes generally rely on chemical treatments followed by the physical removal of contaminated residues, resulting in significant volumes of secondary liquid waste containing residual toxic compounds and potentially hazardous degradation products. In this context, ultrasound-assisted technologies represent a promising approach for CWA destruction, based on acoustic cavitation and the associated physicochemical and sonochemical effects that promote the degradation of toxic compounds and enable the development of integrated decontamination systems adaptable to controlled and continuous-flow operation.

Materials and methods: Two experimental treatment conditions were comparatively investigated using the reference decontamination matrix - M0 (water, 10% isopropanol, and 10% KOH): conventional magnetic stirring and ultrasonic treatment performed in a batch reactor operating at 24 kHz and 400 W, to assess the contribution of acoustic cavitation to the decontamination efficiency of organophosphorus pesticides as chemical warfare agents simulants.

Results: Under magnetic stirring, the reference M0 matrix showed high decontamination efficiency toward both organophosphorus pesticides, although distinct kinetic profiles were observed. Methyl paraoxon (MPO) underwent rapid degradation, reaching approximately 99.94% within 2 min and remaining above 99.97-99.99% throughout the investigated treatment period, whereas chlorpyrifos (CP) exhibited a more progressive response, increasing from approximately 86% at 2 min to over 98% at 5 min and approximately 99.9% after 30 min. The slower initial degradation of CP can be associated with its limited aqueous solubility, while the rapid transformation of MPO indicates its higher susceptibility to alkaline hydrolysis.



a) b) c) d)

Figure 1. Decontamination efficiency of CP and MPO in the M0 reference matrix: a) CP under magnetic stirring; b) CP under ultrasound-assisted treatment; c) MPO under magnetic stirring; d) MPO under ultrasound-assisted treatment.

Conclusions: The developed ultrasound-assisted technology demonstrated a potential for enhancing and accelerating the decontamination of organophosphorus compounds compared with conventional treatment. The results highlight acoustic cavitation as an effective process-intensification strategy, particularly for compounds exhibiting slower degradation under magnetic stirring. Overall, the proposed ultrasonic system provides a promising technological platform for the development of rapid and adaptable CWA decontamination processes.

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TAILORED MXENE-BASED ELECTROCHEMICAL SENSORS FOR HEAVY METAL DETECTION

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Keywords: MXene; nanomaterials; heavy metals; sensors; electrochemical;

Introduction: Heavy metal contamination, including Cr(VI) and Pb(II), poses environmental and health risks even at low concentrations. Conventional analytical techniques, such as atomic absorption spectroscopy (AAS) and inductively coupled plasma mass spectrometry (ICP-MS), require costly instrumentation and laboratory facilities, limiting their use for rapid on-site screening. Electrochemical sensors based on screen-printed electrodes (SPEs) offer a rapid, low-cost and portable alternative, although their analytical performance strongly depends on the electrode material [1]. This work investigates $Ti_3C_2T_x$ MXene and its amino-functionalized derivative as SPE modifiers. Their electrical conductivity, accessible 2D-surface, aqueous dispersibility, and tunable surface chemistry make them promising alternatives to carbon nanotubes for electrochemical sensing [2].
Materials and methods: $Ti_3C_2T_x$ MXene was synthesized by etching Ti_3AlC_2 with LiF/HCl, followed by DMSO intercalation, delamination and sonication. Amino-MXene (NH_2-MXene) was prepared by silanization with (3-aminopropyl) triethoxysilane (APTES). The resulting materials were dispersed by sonication and deposited onto SPEs. Cr(VI) was determined using NH_2-MXene/SPEs in an electrolyte containing 0.1 M HCl and 0.1 M KCl, by amperometry at -0.1 V vs. Ag/AgCl and square wave voltammetry (SWV: pulse amplitude of 25 mV, step potential 5 mV, 10 Hz). Pb(II) was determined using MXene/SPE in acetate buffer by square wave anodic stripping voltammetry (SWASV), with a deposition potential of -1 V and a pulse amplitude of 25 mV.
Results: For Cr^{6+}, the amperometric detection with NH_2-MXene/SPE gave a linear range of 10-1500 µM, a specific sensitivity of 351.58 $mA \cdot M^{-1} \cdot cm^{-2}$ and a LOD of 8.8 µM, better than sensors modified with redox mediators (Prussian Blue/SPE). SWV gave a linear range of 40–1940 µM, a higher sensitivity of 521.07 $mA \cdot M^{-1} \cdot cm^{-2}$ and a LOD of 22.5 µM. The response is attributed to the high conductivity of MXene and to electrostatic preconcentration of $HCrO_4^-/Cr_2O_7^{2-}$ on protonated $-NH_3^+$ groups at acidic pH. For Pb^{2+}, SWASV with MXene/SPE showed a linear range of 10–70 µM, a sensitivity of 5042.02 $mA \cdot M^{-1} \cdot cm^{-2}$ and a LOD of 8.9 µM. The high sensitivity results from the electrochemical preconcentration step, and the narrow range from saturation of active sites. Preliminary data also suggest a second linear regime above 70 µM Pb^{2+}.

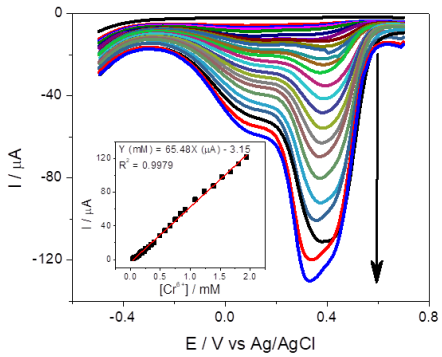


Figure 1. SWV detection of Cr^{6+} using NH_2-MXene/SPE sensors, inset: Ipeak (µA) = f[Cr^{6+}] (mM) calibration.

Conclusions: MXene-modified SPEs were shown to be promising platforms for heavy metal detection: amino-MXene allows Cr(VI) determination over a wide concentration range using two electrochemical techniques, and MXene/SPE combined with SWASV gives high sensitivity for Pb(II). Future work will focus on sensor optimization and validation in real environmental samples.

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DEVELOPMENT AND CHARACTERIZATION OF PURE *GANODERMA LUCIDUM* MYCELIUM-BASED MATERIALS FOR SUSTAINABLE APPLICATIONS

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Keywords: mycelium-based materials; pure mycelium mats; Ganoderma lucidum biomaterial

Introduction: To mitigate environmental damage from non-degradable synthetic plastics, research increasingly focuses on fully compostable, bio-based alternatives. Pure mycelium materials represent a promising, cost-effective, and eco-friendly class of sustainable biomaterials.
Materials and methods: In this study, pure Ganoderma lucidum mycelium mats were grown via Liquid-State Surface Fermentation (LSSF). Upon reaching optimal hyphal colonization, the harvested mats underwent sequential chemical and physical processing, specifically, alkaline deacetylation, chemical cross-linking of the chitin/chitosan matrix, plasticization, and hot pressing, to produce consolidate materials. Furthermore, the materials were investigated in order to obtain morphological and compositional information, by SEM-EDX, FTIR and thermal analyses.



Figure 2 Ganoderma lucidum pure mycelium-based materials

Conclusions: In summary, targeted post-harvest modifications successfully yield functional, robust mycelial biomaterials, highlighting LSSF-cultivated fungal biomass as a cost-effective alternative to non-degradable polymers.

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EEG SIGNAL PROCESSING AS AN INNOVATIVE TECHNOLOGY FOR THE EUROPHYSIOLOGICAL ASSESSMENT OF CONSUMER PREFERENCES

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Keywords: electroencephalography; brain waves; signal processing; consumer preferences; innovative technologies

Introduction:
Recent developments in neurotechnology and signal processing have increased the interest in objective methods for studying human responses. Consumer preferences are commonly assessed through questionnaires, interviews, and behavioral observations, which mainly capture conscious or observable responses. Electroencephalography (EEG) allows the non-invasive recording of brain electrical activity with high temporal resolution and is increasingly used in consumer neuroscience and neuromarketing research [1,4]. The ongoing research examines whether features extracted from EEG signals can be associated with consumer preferences and used to estimate preference responses during interaction with products or sensory stimuli. EEG is used as the main source of neurophysiological information, while other physiological or behavioral measurements may be included for validation when needed.

Materials and methods:
The proposed methodology is based on multichannel EEG recordings acquired under controlled experimental conditions during exposure to selected stimuli. The signals are preprocessed to reduce noise and artifacts, after which relevant characteristics of brain electrical activity are extracted. Spectral analysis considers the main EEG frequency bands, delta (δ), theta (θ), alpha (α), beta (β), and gamma (γ), which represent distinct frequency ranges of the recorded signal. Spectral power, relative power, and power spectral density are used to examine variations in these components. Time, frequency, and time-frequency-domain methods are considered for feature extraction [2], while PSD-based and other EEG-derived features have previously been investigated for consumer preference recognition and classification [3]. The extracted parameters are compared with experimentally established preference responses in order to identify EEG characteristics that differ between preference states.

Results:
At this stage, the research is focused on defining the signal-processing procedure and selecting EEG features that may be relevant for preference assessment. Previous studies indicate that EEG-derived patterns can contribute to the recognition and prediction of consumer preferences, although the results depend on the experimental protocol, preprocessing steps, selected features, and analytical method [1,3,4]. The proposed analysis therefore examines whether measurable changes in brain electrical activity can be used to distinguish different preference responses at the individual level.

Conclusions:
EEG signal processing offers a useful technological basis for studying consumer preferences from neurophysiological activity. Identifying EEG characteristics that vary with preference may contribute to methods for estimating consumer responses from brain activity, alongside conventional declared or observable responses. The study also illustrates the potential of neurotechnology and digital signal processing in the development of new methods for human response assessment.

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FROM MULTILAYER ADSORPTION TO HYBRID ADSORPTION–PHOTOCATALYSIS: BIO-BASED COMPOSITE PLATFORMS FOR COMPLEX WATER DECONTAMINATION

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Keywords: water decontamination; bio-based composites; adsorption; photocatalysis; heavy metals.

Introduction: Water sources with complex compositions frequently contain both inorganic and organic contaminants, while conventional treatment processes are often optimized for a single pollutant class. Within the AquaMat project, multifunctional composite materials and integrated treatment concepts were developed to address simultaneous pollutant removal while improving material utilization and reducing the need for additional chemical reagents [1,2].

Materials and methods: Bio-based and mineral-derived functional components were combined into composite adsorbent and photocatalytic materials. Two complementary treatment strategies were investigated: a multilayer adsorption system in which successive functional zones were designed for differentiated pollutant retention, and a hybrid process coupling adsorption with photocatalytic degradation. Performance was evaluated using model, natural and industrial water matrices containing heavy metals and organic pollutants. Metal concentrations, organic carbon and chemical oxygen demand were monitored using standard analytical techniques.

Results: The multilayer adsorption configuration enabled sequential pollutant removal and efficient distribution of the adsorption load between functional zones. For the investigated metal-containing waters, residual concentrations decreased from the mg/L range to the low µg/L range, while complex industrial matrices also showed substantial reductions in organic load [1]. The hybrid adsorption-photocatalysis approach extended the treatment capability toward simultaneous removal of inorganic and persistent organic contaminants. Depending on the tested matrix, heavy-metal removal exceeded 90%, while reductions of organic indicators were generally in the range of approximately 55-75% [2]. The interaction between adsorption and photocatalysis additionally promoted partial regeneration of active sites during operation, supporting sustained process performance.

Conclusions: The results demonstrate that functionally differentiated adsorption and hybrid adsorption–photocatalysis represent complementary strategies for the treatment of waters with complex contamination profiles. The developed systems combine efficient retention of inorganic pollutants with the removal or degradation of organic contaminants, while the differentiated use of active materials contributes to a more effective distribution of the treatment load. In the hybrid configuration, the interaction between adsorption and photocatalysis further supports the maintenance of material functionality through partial in situ regeneration of active sites. Taken together, these findings indicate that bio-based and mineral-derived composite materials can be integrated into versatile treatment platforms able to address variable water compositions without relying on complex chemical conditioning. The concepts developed within AquaMat therefore provide a relevant basis for the design of modular, adaptable and resource-efficient water-treatment technologies suitable for further validation and scale-up.

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BEYOND ANTIMICROBIAL ADDITIVES: THE ROLE OF MINERAL COMPOSITION IN MICROBIAL ADHESION

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Keywords: cementitious materials; sage extract; silver nanoparticles; microbial adhesion; biofilm formation

Introduction: Microbial colonization of construction materials is a relevant concern for their maintenance and biological durability, encouraging the development of cementitious formulations capable of limiting surface adhesion and biofilm formation. Plant extracts and silver nanoparticles offer potential routes for introducing antimicrobial functionality, as well as other useful properties for cultural heritage protection [1, 2]; however, their activity as individual components does not necessarily translate into equivalent performance after incorporation into a mineral matrix. Microbiological evaluation of the resulting materials is therefore essential to establish whether functionalization inhibits or favours microbial colonization. This study investigates cement–limestone and cement–limestone–tuff materials functionalized with sage extract, alone or combined with silver nanoparticles. Particular emphasis is placed on assessing bacterial and yeast adhesion and biofilm development through quantification of viable surface-adherent cells, aiming to identify how mineral composition and functionalization influence the biological response.

Materials and methods: Cement–limestone and cement–limestone–tuff specimens were functionalized with sage extract in different concentrations or an extract–AgNP system and compared with their corresponding unmodified controls [3,4]. Surface adhesion and biofilm development were assessed by determining viable adherent cells of *Bacillus subtilis*, *Pseudomonas aeruginosa* and *Candida albicans*.

Results: The two mineral matrices exhibited contrasting biological responses. Functionalization of cement–limestone specimens generally favoured bacterial and yeast adhesion under the tested conditions, although a selected AgNP-containing formulation inhibited Bacillus subtilis adhesion. Conversely, functionalized cement–limestone–tuff specimens reduced microbial adhesion relative to their corresponding controls. A selected sage-extract formulation achieved adhesion inhibition of 98.4% for Pseudomonas aeruginosa and 98.2% for Candida albicans. AgNP incorporation did not consistently enhance performance across the tested microorganisms and matrices, highlighting the influence of mineral composition on the biological response. SEM observations revealed fungal colonization at the specimen surface, complementing the microbiological assessment.

Conclusions: The findings demonstrate that mineral composition plays a key role in the biological response of cementitious materials functionalized with sage extract and silver nanoparticles. The contrasting behaviour of cement–limestone and cement–limestone–tuff formulations highlights the need to assess microbial adhesion directly on the resulting materials, since antimicrobial activity of the incorporated components alone cannot predict surface colonization. The reduced bacterial and yeast adhesion observed for selected tuff-containing formulations supports their further investigation, while the variable contribution of AgNPs indicates that nanoparticle addition requires formulation-specific evaluation. Further studies under prolonged exposure and application-relevant conditions are needed to establish the persistence of these effects and their relevance to biological durability.

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SUBSTRATE-ADAPTIVE HYBRID NANOMATERIAL SYSTEMS FOR SUSTAINABLE CONSOLIDATION OF BUILT HERITAGE

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Keywords: cultural heritage; consolidation; hybrid nanomaterials; silanes; sustainable conservation.

Introduction: Porous building materials are progressively affected by environmental exposure, moisture-related processes, biological colonization and repeated degradation cycles. Effective conservation therefore requires consolidating treatments able to improve material cohesion while maintaining compatibility with the original substrate. The NanoConsol project addresses the transfer toward industrially relevant conditions of eco-friendly hybrid technologies based on silanes and nanostructured inorganic materials, with consolidation and additional protective functionalities [1-3].
Materials and methods: Hybrid consolidating systems containing organosilane-based components and selected nanostructured inorganic phases were prepared and evaluated on representative porous mineral substrates. The experimental program included physicochemical characterization of the functional materials and dispersions, followed by comparative assessment of substrate interaction and consolidation performance. Mechanical response, water-related behavior, surface compatibility and complementary protective properties were considered within a multicriteria approach. Formulation and processing parameters were varied systematically to identify conditions suitable for subsequent technological transfer.
Results: The investigated systems showed a composition- and substrate-dependent consolidation response. Selected formulations produced consistent improvements in mechanical performance compared with untreated specimens and corresponding reference treatments, confirming the contribution of the nanostructured component to the overall consolidating effect. The study also demonstrated that the final response depends on the interaction between the inorganic phase, the hybrid matrix and the characteristics of the treated material, supporting a substrate-adaptive rather than universal treatment strategy. The most promising systems retained the multifunctional concept pursued within the project while providing the reproducibility and processability required for progression from laboratory validation toward a functional model and industrially relevant validation.
Conclusions: Hybrid silane–nanomaterial systems provide a versatile platform for the sustainable consolidation of porous building and heritage materials. The obtained results support the development of treatments that combine improved mechanical performance with complementary protective functions while allowing adaptation to substrates with different physicochemical characteristics. The work provides the experimental basis for pilot-scale transfer, independent validation and subsequent demonstration in relevant heritage environments.

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DESIGNING A FLOW INJECTION ANALYSIS SYSTEM (FIA) FOR SIMULTANEOUS DETECTION OF HYDROGEN PEROXIDE USING BIMODAL SENSORS, ON THE SAME SURFACE, AT THE SAME TIME: ELECTROCHEMISTRY (EC) AND SURFACE ENHANCED RAMAN SPECTROSCOPY (SERS) FOR PLANT STUDIES - THEORETICAL AND EXPERIMENTAL CORRELATIONS – EC-SER(O)s –

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Keywords: bimodal sensors, EC-SER(o)S FIA, H_2O_2, Reactive Oxygen Species (ROS), redox signaling, flow analysis.

Introduction: Hydrogen peroxide (H_2O_2) is a key redox signalling molecule involved in plant growth, development, and responses to environmental stress. Its effects depend on its concentration, location, and duration: controlled H_2O_2 production activates defense and acclimation pathways, whereas excessive accumulation can contribute to oxidative damage. Monitoring H_2O_2 dynamics can therefore help evaluate how plant treatments, including biostimulants, influence redox balance and stress tolerance. However, H_2O_2 measurements should be interpreted alongside antioxidant responses, tissue damage, and plant performance, since lower H_2O_2 levels alone do not necessarily indicate greater treatment efficacy. Even though both methods (Electrochemistry-EC [1] and Surface Enhanced Raman Spectroscopy-SERS [2]) were already approached in literature for separate detection of hydrogen peroxide, scientific literature doesn't describe the combination of bimodal sensors using both methods at the same time, on the same surface, for simultaneous detection.

Materials and methods: Different metal phthalocyanines were used to modify the surface of Screen-Printed Carbon Electrodes (SPCE). The electrodes were characterized by SEM/EDX, XRF, FTIR, XRD, Raman and Electrochemistry. The modified SPCE were calibrated in an *offline configuration* (on the same surface, but not at the same time) for peroxynitrite, for its further detection, in PBS pH 9, with both Surface Enhanced Raman Spectroscopy (SERS) and Electrochemistry (EC), for the creation of bimodal sensors. Hydrogen Peroxide (H_2O_2) was used for *online calibration* (on the same surface, at the same time), under the same conditions.

Results: Bimodal sensors were tested against different molecules (such as nitrite, nitrate, hydrogen peroxide and peroxynitrite). The Raman spectrum of hydrogen peroxide exhibited strong peaks around 878 cm^{-1} band and peroxynitrite around 990 cm^{-1} (most likely forming an adduct with the deposited catalyst), as established priorly by DFT (Differential Functional Theory - through theoretical computational determination of molecular vibrations of chemical bonds), in the per-oxo region. For testing the *online configuration* (simultaneous detection with both methods, on the same surface, at the same time) hydrogen peroxide was used to calibrate the system.

Conclusions: The utility of calibration will be further tested on 12 different plant extracts of Mung Beans grown in the absence and presence of cadmium chloride stress, treated with different biostimulant formulations, for studying redox signaling and efficacy of plant treatments. Raman determination on infiltrated leaves with hydrogen peroxide is also envisioned for *in vivo* studies of plants. Electrochemistry is only used for plant treatment efficacy and envisioned for future studies with wearable sensors, apart from the bimodal system, on future projects.

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TOWARD SCALABLE BIO-BASED SYSTEMS FOR SUSTAINABLE DECONTAMINATION OF FRESH PRODUCE

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Keywords: natural surfactants; fresh produce; decontamination; process optimization; circular bioeconomy.

Introduction: Fresh fruits and vegetables may carry microbial contaminants, pesticide residues and surface deposits that require efficient removal without compromising product quality. Bio-based washing systems offer an attractive alternative to conventional chemical treatments, particularly when renewable plant resources and secondary biomass streams are used as sources of functional ingredients [1–3]. The present study addressed the development and scale-up of a multifunctional, plant-derived system intended for the sustainable decontamination of fresh produce.

Materials and methods: A functional model was developed by integrating standardized bio-based intermediates providing complementary surface-active, acidic and phytochemical functions. Process development included optimization of the plant-derived surfactant fraction, definition of critical quality attributes, formulation studies and evaluation of technological compatibility. A multivariate experimental approach was employed to investigate formulation and processing variables, while physicochemical stability, surface activity, operational behavior and compatibility with horticultural matrices were considered as selection criteria. The scale-up strategy was subsequently assessed using the existing industrial infrastructure.

Results: The studies established a reproducible approach for obtaining and standardizing the bio-based surface-active component and provided an experimental framework for the controlled integration of the functional intermediates. The functional model enabled systematic evaluation of formulation and processing variables while maintaining traceability between laboratory and pilot-scale operations. Critical parameters related to physical stability, surface activity, mixing behavior and processability were identified and incorporated into the technological control strategy. Feasibility analysis demonstrated that the proposed process could be transferred to a modular pilot configuration based predominantly on existing industrial equipment, and the resulting process architecture supported controlled preparation, formulation, in-process monitoring, transfer and packaging. The developed framework also enabled subsequent evaluation of microbial-load reduction, pesticide-residue removal and preservation of product quality.

Conclusions: The results demonstrate the technological feasibility of integrating complementary plant-derived functions into a scalable system for fresh-produce treatment. The approach combines biomass valorization, green processing and process intensification and provides a sound basis for further industrial validation and development of sustainable solutions for improving fresh-produce safety.

***Acknowledgements**: This work was supported by the Ministry of Research, Innovation and Digitization (Ministry of Education and Research, National Authority for Research), CCCDI—UEFISCDI, project number PN-IV-P7-7.1-PTE-2024-0607, contract 57PTE/2025, within PNCDI IV.*

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MECHANICAL PERFORMANCE OF LIGHTWEIGHT GEOPOLYMER COMPOSITES BASED ON COAL ASH AND PERLITE

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Keywords: coal ash; geopolymers; perlite; lightweight materials; compressive strength; flexural strength; circular construction.

Abstract: The valorization of coal combustion residues in alkali-activated geopolymers provides an opportunity to reduce the consumption of conventional raw materials while developing lower-density construction products. This study investigates the mechanical performance of lightweight geopolymer composites produced with coal ash from the Rovinari power plant as the primary aluminosilicate precursor and expanded perlite as a lightweight functional additive. The experimental program was developed using a Taguchi L9 design, in which the perlite content and the main alkaline-activation parameters were varied. Mechanical properties were evaluated at 14 and 28 days through flexural and compressive strength measurements, together with the evolution of apparent density. The results showed that incorporating perlite reduced material density, although its effect on mechanical performance depended strongly on the activation conditions. Among the perlite-containing compositions, a mixture incorporating 10 parts of perlite per 100 parts of coal ash achieved, at 28 days, a flexural strength of approximately 3.00 MPa and a compressive strength of 6.51 MPa, with an apparent density of approximately 1.375 g/cm^3. Increasing the perlite addition to 20 parts further reduced the apparent density to approximately 1.258 g/cm^3 while maintaining flexural and compressive strengths of approximately 2.41 and 3.20 MPa, respectively. These results demonstrate that lightweight geopolymer composites based on Rovinari coal ash can retain useful mechanical integrity when perlite is incorporated and appropriate activation parameters are used. The observed balance between density reduction and mechanical performance highlights the potential of these materials for lightweight, non-structural construction applications, including geopolymer-based plastering systems.

Acknowledgment. *This work was supported by the Academy of Romanian Scientists through the AOSR-TEAMS-IV 2026-2027 research program, project "Development and digital optimization of sustainable geopolymer plasters based on local mineral waste and functionalized with perlite", contract no. 549/20.04.2026.*



SECTION 2 - Bioresources, biotechnologies and biorefining

CICHORIUM INTYBUS L. AS A SUSTAINABLE BIORESOURCE: INULIN AND PHYTOCOMPOUNDS FOR BIOTECHNOLOGICAL AND HIGH-VALUE APPLICATIONS

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Keywords: *Cichorium intybus*; inulin; bioresources; biotechnology; biorefining

Introduction: *Cichorium intybus L.* (chicory) is a renewable plant bioresource with important potential for integrated valorization in food, pharmaceutical and nutraceutical biotechnology. Its roots are particularly rich in inulin, a fructan with technological and functional relevance, while aerial and underground organs contain polyphenols and other phytocompounds that may contribute to biological activity. This work aimed to assess chicory as a multifunctional bioresource and to highlight pathways for the recovery of inulin and associated bioactive fractions within sustainable, high-value bioprocessing strategies.

Materials and methods:A literature-based scientific assessment was performed using data on the phytochemical composition of *C. intybus*, with emphasis on inulin and phenolic constituents, their functional properties, extraction approaches and opportunities for integrated biomass valorization. Conventional and emerging processing strategies were comparatively considered in terms of selective recovery, preservation of bioactivity, reduced resource consumption and potential reuse of residual plant biomass.

Results:Chicory provides complementary fractions suitable for cascading valorization. Inulin-rich root material can serve as a source of functional carbohydrate ingredients and as a substrate for biotechnological conversion, while phenolic-rich fractions offer additional potential for antioxidant and functional applications [1-3]. An integrated processing concept can therefore combine primary recovery of inulin with extraction of secondary phytocompounds and subsequent utilization of residual biomass. Such a cascade increases the value obtained from the same plant resource and is consistent with circular bioeconomy and biorefinery principles [4,5].

Conclusions:*Cichorium intybus L.* represents a promising sustainable bioresource for biotechnology-oriented applications. The combined valorization of inulin, phytocompounds and residual biomass supports a transition from single-product extraction toward integrated biorefining. Chicory-based processing may consequently contribute to the development of functional ingredients and other high-value bioproducts while improving resource efficiency and reducing biomass waste.

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A RESPONSE-SURFACE STUDY OF A REUSABLE SULFONATED CARBON FROM NEEM SEED CAKE/SHELL FOR THE PRODUCTION OF BIODIESEL FROM CASTOR, NEEM, AND WASTE COOKING OILS

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Keywords: sulfonated carbon catalyst; neem seed cake/shell; response surface methodology; biodiesel; waste valorization

Introduction: Acid-tolerant heterogeneous catalysts are needed to convert non-edible and waste oils, which often carry a high free fatty acid content, into biodiesel without the saponification losses typical of homogeneous alkali catalysis [1]. Sulfonated carbon materials, in which –SO_3H groups are grafted onto an incompletely carbonized biomass support, are among the most promising such catalysts [2,5], but most reported precursors are unrelated to the oil being converted. Sulfonated catalysts have been reported for neem (Azadirachta indica) seed oil conversion [3], but not one derived from the neem seed's own cake/shell. Building on our earlier characterization of castor, neem, and waste-cooking-oil feedstocks and their seed cakes as candidate raw materials for an integrated biorefinery [4], we report a neem-seed-cake/shell-derived sulfonated carbon catalyst, NSCS-SO_3H, and its systematic response-surface optimization for biodiesel production from three chemically distinct oils: castor, neem, and waste cooking oil.

Materials and methods: NSCS-SO_3H was prepared by phosphoric-acid activation of neem seed cake/shell (85% H_3PO_4, 2:1 w/w, 24 h), carbonization (400 °C, 2 h), and sulfonation with concentrated H_2SO_4 (150 °C, 4 h reflux), and characterized by FTIR, XRD, N_2-BET, and SEM-EDX. A four-factor, three-level Box–Behnken design (methanol:oil ratio 6–12, temperature 50–70 °C, time 60–300 min, catalyst loading 2.5–5 wt%; 54 runs, MINITAB 17) was used to optimize the simultaneous esterification–transesterification of castor seed oil (CSO), neem seed oil (NSO), and waste cooking oil (WCO). Catalyst reusability was assessed over four reaction cycles, and the fatty acid methyl ester (FAME) profile and fuel properties of the resulting biodiesels were determined by GC-MS and against ASTM D6751, respectively.

Results: FTIR and EDX confirmed successful grafting of –SO_3H groups (63.25 wt% S), with a BET surface area of 346.2 m^2/g and pore volume of 0.154 cm^3/g. Reduced quadratic response-surface models fitted the yield data well for all three oils (R^2 = 94.9–99.8%), with methanol:oil ratio the dominant driver of yield and no significant two-way interactions in any model. Validated optimum yields were 94.48 ± 0.07% (castor biodiesel), 95.05 ± 0.06% (neem biodiesel), and 94.79 ± 0.04% (waste-cooking-oil biodiesel). The catalyst retained more than 84% of its initial activity through three reuse cycles, with a sharper decline by the fourth. GC-MS identified oleate, palmitate, and laurate/undecenoate esters as the dominant methyl esters, and the biodiesels met ASTM D6751 limits for viscosity, acid value, flash point, cold-flow properties, and cetane number, with the single exception of waste-cooking-oil-biodiesel density, which marginally exceeded the standard's upper limit.

Conclusions: NSCS-SO_3H, synthesized from neem seed cake/shell, is an active, reusable solid acid catalyst capable of producing ASTM-compliant biodiesel from three chemically distinct feedstocks under a single response-surface-optimized process. Because the catalyst is derived from the same seed cake left over after oil extraction, it offers a low-cost, closed-loop route to solid acid catalysis directly compatible with an integrated oilseed biorefinery.

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SYNERGISTIC ACTION OF MICROBIAL CONSORTIA MODULATE COLOSTRUM PROTEOLYSIS AND ANTIOXIDANT ACTIVITY

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Keywords: colostrum; microbial fermentation; proteolysis; antioxidant activity; peptides.

Introduction: Colostrum is a nutrient-rich biological matrix containing proteins and other bioactive compounds with important functional properties [1]. Microbial fermentation may enhance its biotechnological potential by promoting the release of low-molecular-weight peptides, while also modifying antioxidant activity [2,3]. This study aimed to evaluate the synergistic action of kefir-kombucha microbial consortia, at different fermentation parameters on proteolysis degree and antioxidant activity of bovine and sheep colostrum peptides.
Materials and methods: Bovine and sheep colostrum samples were fermented using three microbial inocula: kefir (A), kombucha (B), and a mixed kefir–kombucha consortium (C), at 30 and 37 °C, for 48 and 72 h. Protein and peptide content was determined using BCA and OPA assays, respectively, while antioxidant activity was evaluated by the ABTS method. Low-molecular-weight peptide fractions (MW<3 kDa) were subsequently obtained by centrifugal ultrafiltration and evaluated for protein content and antioxidant activity.
Results: Fermentation induced proteolytic changes in both bovine and sheep colostrum, as demonstrated by the OPA assay. The antioxidant activity of the <3 kDa peptide fractions varied according to the microbial consortium. ABTS values ranged from 41.46 to 49.17 mM TE/g DW for bovine fractions (1A–1C) and from 42.51 to 47.96 mM TE/g DW for sheep fractions (2A–2C). Significantly higher ($p < 0.05$) antioxidant activity was recorded for the fractions fermented with the kefir–kombucha consortium (1C and 2C) compared with the corresponding individual-culture fermentations, indicating a synergistic effect.

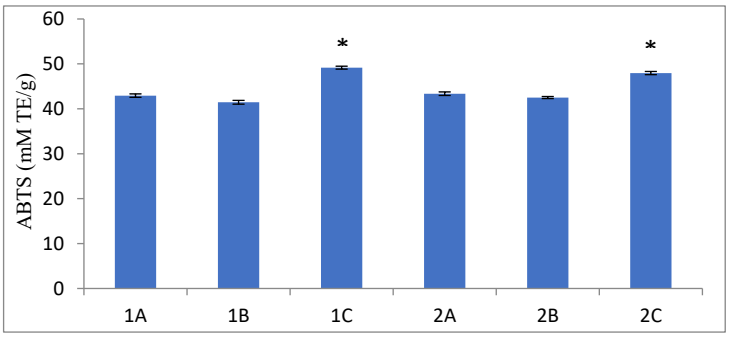


Figure 1. Antioxidant activity of peptide fractions with MW<3 kDa obtained from fermented bovine (1A–1C) and sheep colostrum (2A–2C). Values are expressed as mean ± SD (n = 3). *p<0.05

Conclusions: Fermentation with the kefir–kombucha consortium promoted proteolytic changes in bovine and sheep colostrum and increased the antioxidant activity of the resulting peptide fractions. These results highlight the importance of microbial consortium selection for the isolation of bioactive peptides with antioxidant potential for applications in food and biomedical industries.

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EVALUATION OF TOTAL PHENOLIC CONTENT IN SELECTED HALOPHYTIC SPECIES USING DIFFERENT EXTRACTION TECHNIQUES

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Keywords: halophytes; green extraction, polyphenols

Introduction: Halophytes are highly specialized plant species adapted to saline environments and have attracted increasing attention as promising sources of phenolic compounds and other bioactive metabolites [1], [3]. The present study aimed to comparatively evaluate the total phenolic content (TPC) of ethanolic extracts obtained from three halophytic species collected from the Danube Delta–Black Sea region—*Salicornia europaea*, *Puccinellia maritima*, and *Suaeda maritima*. Three extraction approaches were investigated, namely continuous-stirred maceration (CSM), ultrasound-assisted extraction (UAE), and enzyme-assisted extraction (EAE) [4], [5], in order to assess their efficiency in phenolic compound recovery and to explore the potential of these species as natural sources of phenolic-rich bioactive compounds.
Materials and Methods: Ethanolic extracts (70%, v/v) were prepared from dried whole-plant material of the investigated halophyte species. A constant biomass-to-solvent ratio of 1:10 (m/v) was maintained for all extraction procedures. Continuous-stirring maceration (CSM) was performed for 72 h at a constant agitation speed of 250 rpm. Continuous agitation ensured the renewal of the solvent layer in contact with the plant material, thereby facilitating mass transfer and maintaining favorable diffusion and dissolution conditions throughout the extraction process. Ultrasound-assisted extraction (UAE) was carried out according to the adapted method after Ma et al. [4]. Extraction was performed under ultrasonic power of 550 W using three 10-min sonication cycles, separated by 15-min resting intervals. Enzyme-assisted extraction (EAE) was conducted according to the method adapted after Jeong et al. [2], Cellulase was used at a concentration of 1%, and the samples were incubated for 1 h at 40 °C. The total phenolic content (TPC) of the obtained extracts was determined spectrophotometrically using the Folin–Ciocalteu assay, with caffeic acid as the calibration standard. The results were expressed as milligrams of caffeic acid equivalents per gram of dry weight (mg CAE/g DW). Measurements for TPC assays was performed in triplicates.
Results and Discussion: The extracts obtained from the analyzed halophyte species contained substantial amounts of phenolic compounds. Among the species investigated, *Salicornia europaea* and *Suaeda maritima* consistently exhibited higher activity than *Puccinellia maritima*, irrespective of the extraction method applied (Table 1).

Table 1. The Total Phenolic Content (mg CAE/g DW) and the dry weight (%) of the extracts from halophyte species depending on extraction method.

Species	DW	CSM	DW	UAE	DW	EAE
Salicornia europaea	2.45	12.49 ± 0.27	2.14	16.57 ± 0.61	2.31	14.23 ± 0.97
Puccinellia maritima	5.38	5.87 ± 0.63	4.76	3.63 ± 0.35	4.92	7.34 ± 0.41
Suaeda maritima	2.76	10.4 ± 0.75	2.47	11.78 ± 0.77	2.51	11.21 ± 0.76

The total phenolic content of the extracts increased in the following order: CSM < EAE < UAE ($p < 0.05$), highlighting the superior extraction efficiency of ultrasound-assisted extraction, in the case of *Salicornia europaea* and *Suaeda maritima.*
This enhanced recovery may be associated with ultrasound-induced cavitation, which promotes structural disruption of plant tissues, improves solvent penetration, and facilitates mass transfer between the plant matrix and the extraction medium, thereby increasing the release of intracellular phenolic compounds.

Conclusions: The investigated halophytic species showed relatively high total phenolic contents, although extraction efficiency varied depending on the plant source and the method employed. Overall, UAE proved to be the most effective approach for phenolic recovery, followed by EAE and CSM. These findings emphasize the potential of halophytes as promising natural sources of phenolic bioactive compounds and support their further exploitation in food, nutraceutical, and pharmaceutical applications.

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FUNCTIONALIZATION OF GLASSY CARBON ELECTRODES WITH POLYCARBOXYLIC ARYL DIAZONIUM SALTS FOR ELECTROCHEMICAL DETECTION OF SILVER IONS

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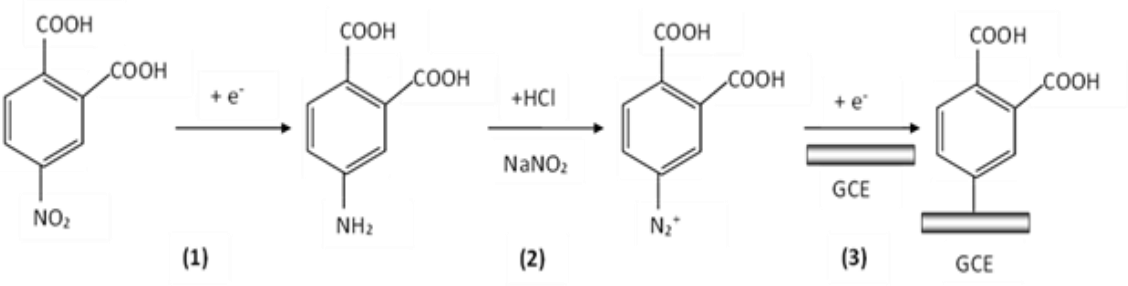
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Keywords: polycarboxylic aryl diazonium salts, electrochemical sensor, silver ions detection

Introduction: Electrochemical grafting of diazonium salts onto carbon-based electrodes is one of the most widely used approaches, offering high layer stability, controlled thickness, enhanced sensitivity, and reduced surface passivation [1, 2]. Some of electrode modification strategies including the reduction of nitro groups to amino may enable more robust and efficient surface functionalization compared to the conventional amino-based approaches [3]. In this work, a procedure for glassy carbon (GC) electrode surface functionalization through the electrografting of polycarboxylic aryl diazonium salts is described.

Materials and methods: The polycarboxylic aryl diazonium salt of 4-nitrophtalic acid (4-NPA) was generated *in situ* and followed by its covalent immobilization onto GC electrode surface. The electrografting process was rapid, about 2 min, and has been carried out in the same solution used for: (1) electroreduction of nitro groups to amino moieties, (2) transformation of amino to diazonium with nitrous acid and (3) electrografting of polycarboxylic aryl diazonium salt, as it shown in Scheme 1. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were used to characterize the surface state after each step of the electrografting process. An equimolar solution of 1 mM ferri/ferocyanide ($[Fe(CN)^6)]^{3-}$/ $[Fe(CN)^6)]^{4-}$) prepared in PBS solution (pH 7.4) supplemented with KCl was employed as a reversible redox probe for monitoring the surface modification after electrografting step.

Results: Well-defined CV peaks characteristic of a diffusion-controlled redox process were obtained both at the bare and the modified GC electrodes. The two peaks corresponding to $[Fe(CN)^6)]^{3-}$/ $[Fe(CN)^6)]^{4-}$ redox couple appeared at 0.293 V for the reduction and at 0.193 V for the oxidation process. The relatively small peak-to-peak separation value (ΔEp = 0.105 V) indicated a fast and reversible electron transfer process. Also, the EIS spectra shown an increase in the charge transfer resistance and confirmed the formation of the grafted layer. The optimum parameters (reduction potential, -0.6 V; reduction time, 60 s; applied current, -0.02 μA; deposition time, 30 s) were selected based on the highest electrochemical performances, characterized by enhanced redox currents or lower charge-transfer resistance.



Scheme 1. Electrochemical grafting of polycarboxylic aryl diazonium salt of 4-nitrophtalic acid on the glassy carbon (GC) electrode surface.

Conclusions: The optimized electrografting conditions enabled the formation of a thin and homogeneous film, resulting in enhanced electron-transfer properties, improved reproducibility, and a lower detection limit. The developed electrochemical sensor based on polycarboxylic aryl diazonium salts was successfully applied for the determination of silver ions in aqueous solutions.

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VALORIZATION OF SWEET WHEY THROUGH WATER KEFIR FERMENTATION

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Keywords: SCOBY; Polyphenols; Antioxidant activity; Dextran; Prebiotic activity

Introduction: Whey is a major, underexploited dairy by-product rich in proteins, lactose, vitamins, and minerals [1]. Water kefir (WK) is a fermented beverage produced by a symbiotic culture of bacteria and yeasts embedded in a dextran matrix, valued for its multibiotic (prebiotic, (para)probiotic, and postbiotic) profile. Few studies fermented whey or whey-derived ingredients with kefir grains [2-5], but none tested unprocessed sweet whey powder in a standard WK recipe or its effect on dextran and prebiotic activity. This study evaluates the effect of adding sweet whey powder on the polyphenolic content, antioxidant activity, carbohydrates, volatile compounds, prebiotic activity, and dextran structure of water kefir.

Materials and methods: Water kefir grains were activated in a sugar-lemon solution and then used to ferment, for 5 days at 30 °C, a standard recipe (5% sugar, lemon slices) with (WKW) or without (WK) 1% (w/v) sweet whey powder. Whey powder was characterized by proximate composition, elemental and isotopic analysis, trace metal content, color, thermogravimetry, and microbiological safety. The fermented beverages were assessed for total polyphenol (TPC), flavonoid (TFC), and hydroxycinnamic acid (THA) content; antioxidant activity (DPPH, FRAP, CUPRAC); total carbohydrates (TC); volatile organic compounds (GC-MS/MS); and prebiotic activity on *Limosilactobacillus reuteri* and *Lactiplantibacillus plantarum*. Dextran extracted from the kefir grains was analyzed by FTIR and X-ray diffraction (XRD).

Results: The proximate composition of the whey powder was 7.6 ± 0.5% moisture, 17.4 ± 1.9% protein, 1.17 ± 0.08% lipid, 65.46 ± 4.72% carbohydrates, 7.1 ± 0.2% ash, and 2.05 ± 0.15% NaCl, with a balanced nutritional and mineral profile overall and toxic elements (Cd, Pb, As) below admissible limits. Compared with WK, WKW had significantly higher TPC (+33%), TFC (+148%), THA (+149%), and antioxidant activity (+52% DPPH, +136% FRAP, +312% CUPRAC), while total carbohydrates decreased by about 40%. Several monoterpene alcohols (linalool, terpinen-4-ol, α-terpineol, citronellol, geraniol) decreased or disappeared in WKW, whereas butylated hydroxytoluene, di-tert-butylphenol, n-hexadecane, and palmitic acid increased. WK and WKW similarly stimulated the growth of both *L. reuteri* and *L. plantarum*, with no inhibitory effect from whey. Dextran extracted from WKW retained the typical α-glucan FTIR fingerprint but showed lower crystallinity (50% in WKW vs. 67% in WK) and additional FTIR features, suggesting incorporation of peptide fragments from whey.

Conclusions: Unprocessed sweet whey powder is a promising ingredient for functional water kefir beverages: it increases the polyphenolic content and antioxidant activity, modulates the volatile profile, reduces the carbohydrate content, and preserves the prebiotic activity of the fermented product, while inducing discrete structural changes in the grain-derived dextran. Future work will optimize the fermentation parameters and further investigate the microbiome modulation induced by whey.

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ULTRASONIC LYSIS AND SEQUENTIAL FRACTIONATION OF BREWER'S SPENT YEAST FOR OBTAINING BIOACTIVE-ENRICHED FRACTIONS

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Keywords: polyphenols, proteins, flavor peptides, antioxidant activity, tangential flow filtration

Introduction: Food and beverage industry represents one of the most extensive and rapidly evolving sectors worldwide. Adapting the production chains to the current sustainability demands is essential for long-term environmental conservation and could be addressed by adding value to the industrial waste products [1]. Spent brewer's yeast (SBY), a by-product which the beer industry generates and discards constantly in tonne-scale quantities, stands out as a valuable biomolecular pool, given its content of natural proteins, beneficial carbohydrates, vitamins, minerals and antioxidants derived from hop-enriched fermentation process [2]. The state-of-the-art literature reports SBY as an emerging source of functional food bio-additives, especially proteins, vitamins, and small flavor peptides (γ-glutamyl peptides and their derivatives) that confer umami and kokumi taste [3, 4]. In the present work, we coupled ultrasonic lysis with sequential tangential flow filtration to obtain fractions enriched in specific biomolecules.

Materials and methods: To release the intracellular content of SBY cells, the biomass was lysed using a high highly efficiency mechanical method, i.e. ultrasonication. The SBY extracts (SBYE) were obtained by collecting the supernatant from the centrifuged lysed samples. The yeast extracts were passed successively through ultrafilter membranes of decreasing molecular cut-offs (MWCOs) using a tangential flow filtration system (TFF). Evaluation of the process separation efficiency and the biochemical profiling of the filtration fractions, were performed by assessing the total content of proteins, polyphenols (TPC), flavonoids (TFC) and hydroxycinnamic acids (THA) and the cupric reducing antioxidant activity (CUPRAC). High-performance thin layer chromatography (HPTLC) was employed to assess flavor peptides in the fractions obtained by TFF, focusing on the identification of umami flavor compounds (sodium monoglutamate – MSG, adenosine-5'-monophophate – AMP, guanosine-5'-monophosphate – GMP, inosine-5'-monophosphate – IMP) and kokumi flavor peptides (glutathione – GSH, γ-glutamyl-leucine – γGL, γ-glutamyl-tyrosine – γGT).

Results: The protein levels of the filtration fraction decreased proportionally to the membrane MWCOs, thereby confirming efficient separation of the high molecular mass proteins through the TFF process. In the fractions which expected to be the richest in small flavor peptides (10 kDa permeate, 3 kDa retentate and permeate), the antioxidant activity declined progressively, indicating a concomitant separation of antioxidant molecules. The trend can be largely attributed to the considerable loss of polyphenols, observed in the TPC determinations, with only slight decreases of TFC and HAT levels. HPTLC analysis revealed bands corresponding to compounds carrying marginal groups NH_2 – MSG, GSH, γGT and γGT in the <3 kDa permeate fractions.

Conclusions: TFF is an accessible and easily implementable method for processing SBYE from optimized ultrasonic lysis for separation and enriching fractions in targeted compounds, e.g., flavor peptides, which can be used to enhance food taste and quality as natural alternatives to conventional food additives.

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PROPERTIES AND SUITABILITY OF DIATOMACEOUS EARTH FROM PĂTÂRLAGELE QUARRY FOR ROTARY PAN GRANULATION

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Keywords: diatomite, granulation, rotary pan granulator, polyvinyl alcohol

Introduction: Diatomaceous earth (DE), also known as diatomite, is a a soft, lightweight sedimentary rock made from the fossilized skeletal remains of microscopic, single-celled algae called diatoms [1]. It is a valuable resource that is used in various applications such as agrochemistry, filtrations, pest control, environmental remediation [2, 3] etc. The aim of this study is to characterize diatomite as a raw material and to utilise it for granulation tests using a custom made rotating pan granulator with further uses in agricultural applications.
Materials and methods: DE from Pătârlagele quarry (Buzău County, Romania) was first grinded using a Retsch PM 100 ball mill. Granulometry tests were made to establish particle dimensions. DE was characterized using infrared spectroscopy (FT-IR), thermogravimetry (TGA), X-Ray diffraction (XRD), scanning electron microscopy (SEM) and porosimetry methods (BET). The cationic exchange capacity (CEC) was determined by atomic absorption spectroscopy. The sum of the released cations was determined and considered as CEC. DE (200 g) was used for granulation tests with a 3% polyvinyl alcohol (PVA) solution (80 mL) as a binder for granule formation. Granulation time was 1 hour, at 30 rpm anticlockwise rotation speed of the rotating pan granulator. The DE granules were left to dry at room temperature, and were characterized by SEM, FT-IR, XRD and CEC.
Results: After grinding, the granulometry tests showed that the particle dimensions of DE were > 140 µm (5.57%), < 140 µm (62.6%), < 80 µm (28.1%) and < 45 µm (3.72%). FTIR analysis of DE confirmed the presence of peaks at~ 3400 cm^{-1} (corresponding to –OH groups of water molecules adsorbed by Si-OH groups), ~1600 cm^{-1} (OCO), ~1100-1000 cm^{-1}(–Si – O – Si–) which is characteristic for DE [3]. TGA analysis of DE samples showed that the sample remained stable until 258^0C. XRD analysis indicated that the crystalline fraction in DE is quartz. The diatom frustules, having a median dimension of 5,4 µm represent the main component of Pătârlagele DE. Amorphous SiO_2 (opal-A) was found to be 81.2–84.1% and crystalline SiO_2/quartz less than 0,9% out of about 85% total silica content. The CEC of DE sample was found to be 53.14% and remained unchanged after the granulation process. SEM analysis showed the presence of well-defined structures, characteristics to diatom skeleton (Fig. 1). FT-IR spectra of PVA showed characteristic bands around ~2900cm^{-1} (-CH_2-) and in the interval 1400 cm^{-1} - 1300 cm^{-1} (-OH, C-H). The peak at ~1140 cm^{-1} has been assigned to (C–O) stretching vibrations in C–OH groups of the crystalline polymer phase [4]. DE granules (Fig. 2) FT-IR spectra showed characteristic bands of both DE and PVA.

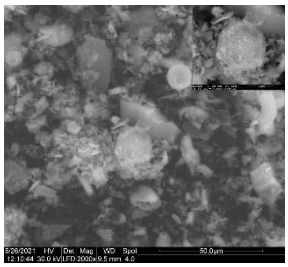


Fig. 1. SEM image of Pătârlagele diatomite



Fig. 2. Diatomite granules obtained on custom made pan granulator.

Conclusions: Our granulation tests concluded that the characterized diatomite from Pătârlagele quarry can be granulated easily by using PVA as a binder. The concentration of PVA will be varied in future experiments to optimize the granule properties. Other binders and fillers will be tested as to compare their usability in the granulation process. Also, diatomite can be used in combination with other fertilizers as to improve their stability and release kinetics when used for soil treatments.

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DETECT-DEGRADE-SUSTAIN: INTEGRATED BIODEGRADATION AND REAL-TIME BIOSENSING FOR SUSTAINABLE ANTIBIOTIC MANAGEMENT IN WATER SYSTEMS

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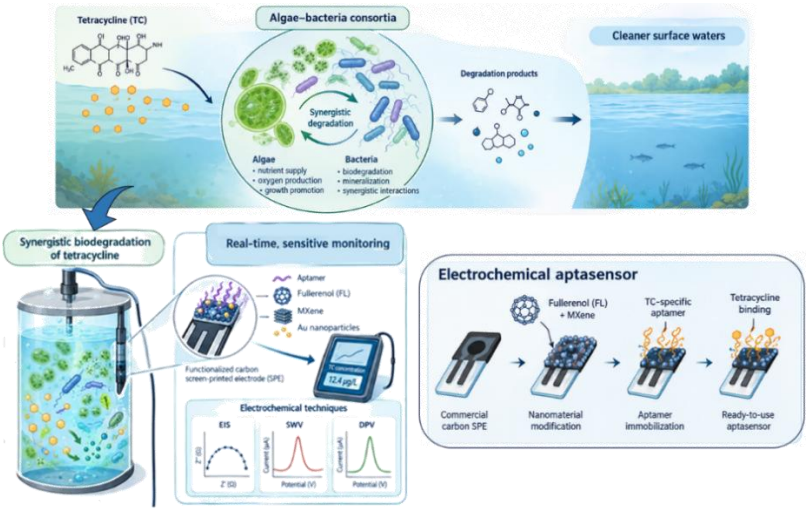
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Keywords: antibiotics, bacteria, bioremediation, microalgae, aptasensors

Introduction: Tetracycline (TC) is a broad-spectrum antibiotic extensively used in both human and veterinary medicine. Due to its incomplete metabolism and limited removal by conventional wastewater treatment, TC persists as a pollutant in aquatic environments, where it exerts selective pressure for antibiotic-resistant bacteria, a phenomenon increasingly recognized as one of the most pressing global health threats[1]. Our study aims to develop an integrated system combining biodegradation employed by a symbiotic consortium of microalgae and bacteria, along with real-time, highly sensitive detection using TC-specific electrochemical aptasensors for the sustainable management of antibiotic pollution in surface waters.



Materials and methods: The antibiotic biodegradation potential of a *Chlorella vulgaris -Pseudomonas aeruginosa -Bacillus subtilis* consortium was evaluated in TC-contaminated wastewater (≤50 mg/L), optimizing glucose (100–1000 mg/L), pH (6–9), and temperature (25–35°C). TC removal and biomass growth were monitored spectrophotometrically over 10 days, with SEM/FTIR used to assess TC-induced morphological and structural changes. In parallel, TC concentration[2] was tracked using electrochemical aptasensors based on carbon screen-printed electrodes functionalized with 2D nanomaterials (fullerenol, MXene) and target-specific aptamers. **Results**: The *C. vulgaris* and *B. subtilis* consortium removed up to 80% TC through adsorption followed by biodegradation under optimal conditions. SEM and FTIR confirmed the formation of an extracellular polymeric matrix (EPS) that preserved cellular integrity and mediated antibiotic uptake through characteristic band shifts associated with polysaccharide, carboxylate, and phospholipid groups. Analytical performances of the TC-specific aptasensor were evaluated using EIS, SWV, and DPV, the Apt-FL-Glu/SPE achieving a sensitivity of 299.4 Ω dec^{-1} (range 0.05–45 nM, LOD 0.01 nM) for tetracycline detection. **Conclusions**: By coupling biodegradation with real-time monitoring, this work lays the groundwork for autonomous, sustainable strategies to manage antibiotic-contaminated surface waters. Future efforts will aim to extend the method's specificity and efficiency to additional antibiotic classes, thereby broadening its applicability within green remediation technologies for water treatment.

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ISOLATION AND CHARACTERIZATION OF A MULTIFUNCTIONAL PEDIOCOCCUS ACIDILACTICI STRAIN FROM KOMBUCHA CULTURES

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Keywords: strain isolation; complex microbial communities; lactic acid bacteria; quorum quenching; spermidine

Introduction: Kombucha is a complex microbial ecosystem and a valuable source of microorganisms with complementary technological and metabolic traits [1]. This work aimed to isolate a lactic acid bacterial strain from a green-tea Kombucha culture and characterize its identity and multifunctionality, focusing on quorum-quenching capacity and spermidine production.

Materials and methods: Green tea (6 g leaves infused per L) supplemented with sucrose (90 g L^{-1}) was inoculated with a Kombucha pellicle derived from pollen fermentation [2] and fermented at 28°C for one week. On the final day, samples were collected and filtered through a 0.45 µm membrane to minimize yeast interference. Bacterial isolates were obtained under microaerobic conditions using the agar sandwich technique in Mann–Rogosa–Sharpe (MRS) medium, incubated at 37°C for 2–3 days, and subsequently purified in liquid MRS medium [3]. Isolates were evaluated by Gram staining and optical microscopy. The lactic acid bacteria (LAB) from the isolates were rapidly identified using the API 50 CHL carbohydrate test kit (BioMerieux, France). In the selected LAB, quorum-quenching (QC) activity against acyl-homoserine lactone signals was screened using the *Chromobacterium violaceum* CV026 biosensor strain [4]. Polyamine-producing isolates were selected by cultivation on Moeller decarboxylase broth, followed by polyamine selective extraction, derivatization with benzoyl chloride, and separation by HPLTC [5]. The LAB strain exhibiting QC activity and high spermidine production was identified using a polyphasic taxonomy approach.

Results: The workflow used for isolation and screening of LAB from Kombucha community enabled recovery of MM-3a strain, with high quorum-quenching capacity and significant spermidine production. These complementary traits distinguish the isolate from a solely acidifying starter and support its further investigation as a functional microbial culture for controlled fermentation and/or bioresource production applications. Polyphasic characterization assigned the isolate to *Pediococcus acidiliactici*. A functional LAB strain, L5, identified as *P. acidiliactici*, was already demonstrated to have a significant biotechnological potential [6]. MM-3a strain identified characteristics qualify it also as a potential plant biostimulant strain [7].

Conclusions: Kombucha cultures can serve as reservoirs of functionally valuable microorganisms. The isolation of *P. acidiliactici* MM-3a links a reproducible selective-cultivation and identification workflow with two relevant traits: interference with AHL-regulated microbial communication and spermidine biosynthesis. The strain show promising function for further development of functional food or as biostimulant.

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VALORIZATION OF AGRO-INDUSTRIAL BY-PRODUCTS INTO A MULTIFUNCTIONAL PECTIN INGREDIENT FOR FUNCTIONAL GUMMIES

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Keywords: apple pomace; barley husks; fermentation; multifunctional pectin; gummies

Introduction: Agro-industrial by-products are renewable sources of hydrocolloids and bioactive compounds, but their integrated recovery and direct use in foods remain challenging [1,2]. This work aimed to valorize apple pomace and barley or two-rows barley husks through an integrated bioprocess, that involve in the first step fermentation into a Kombucha culture, to enhance accessibility of the polyphenols, biosilica, and pectin. The resulting multifunctional pectin-rich preparation was used to produce a soft-gummy prototype.

Materials and methods: Apple pomace from different varieties (Golden, Gala, Ionathan) and barley/two row barley husks were dispersed in water, homogenized by colloidal milling, and fermented for 15 days with a Kombucha symbiotic community of yeast and bacteria (SCOBY) with demonstrated capacity to enhance bioavailability of plant material ingredients [3]. At the end of the fermentation cycle, the cellulose membranes was separated, and the polysaccharides, including pectin, polyphenols and soluble silicon species were extracted into fermentation broth by flow-through ultrasonication. The liquid fraction was separated, vacuum-concentrated and spray-dried. In the resulting powder were determined: total polysaccharides, by phenol-sulfuric acid method [4], galacturonic acid and methylester contents by a combined enzymatic and colorimetric method [5], total polyphenol with Folin-Ciocâlteu reagent [6], soluble silicon species, with silicomolybdic spectrophotometric method [7]. The resulting powder was characterized by viscosity assay and ferric reducing antioxidant power, FRAP [6]. For gummy preparation, xylitol and the multifunctional pectin were homogenized and vacuum-mixed, heated to ensure dissolution, molded, cooled, and dried/matured under controlled conditions.

Results: Across the investigated raw-material variants, the resulting composition contained 68.1–71.3% total polysaccharides, including 50.7–52.5% pectin, together with 11.14–14.87% short-chain fatty acids, 57.3–68.2 mg polyphenols expressed as gallic acid equivalents, and 142.2–147.8 mg soluble silicon species per 100 g. A 4% aqueous solution showed a viscosity of at least 400 mPa·s at 25 °C, while FRAP activity was 90–102 µmol Trolox equivalents/ml. These properties supported its use as a structuring and functional ingredient. Process optimization for the gummy prototype focused on complete pectin dissolution, gelation pH and casting viscosity, addition of thermosensitive polyphenols at ≤70 °C, controlled cooling, and drying/maturation.

Conclusions: The integrated bioprocess developed in this work converts fruit- and cereal-processing side streams into a pectin-rich preparation that combines technological functionality with retained polyphenols and biosilica fractions. Its successful incorporation into soft gummies demonstrates a practical route from food industry by-products to a consumer-oriented food prototype and supports further formulation, sensory and shelf-life studies.

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FROM MEDICINAL PLANT RESIDUES TO MULTIFUNCTIONAL BIOACTIVE AND NANOSTRUCTURED FORMULATIONS FOR SUSTAINABLE AGRICULTURE

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Keywords: medicinal plant residues; circular bioeconomy; green synthesis; nanostructures; sustainable agriculture.

Introduction: Medicinal plant residues represent valuable renewable sources of bioactive compounds and can support the development of sustainable agricultural inputs. In this study, residues of *Momordica charantia* L. and *Calendula officinalis* L. were valorized as raw materials for multifunctional formulations, either as bioactive extracts or as media for the green synthesis of metal and metal oxide nanostructures [1-3].

Materials and methods: Hydroalcoholic extracts were obtained from plant residues and characterized for their phytochemical and antioxidant properties. Selected extracts were further used for the phytosynthesis of silver-, copper- and zinc-based nanostructures without additional synthetic reducing agents. The resulting systems were evaluated for antimicrobial activity, inhibition of microbial adhesion and biofilm formation, and their effects on seed germination and early root development.

Results: The obtained formulations showed a broad multifunctional biological response. *M. charantia*-derived extracts displayed antimicrobial activity and a selective effect on plant development, stimulating germination and root growth of the target crop while inhibiting selected competing plant species [1]. The use of the same type of plant-derived matrices for green synthesis led to Ag- and Cu-based nanostructured formulations that maintained antimicrobial and anti-biofilm activity and also produced a differentiated response in plant assays, with stimulation of *M. charantia* development and inhibition of competing species [2]. Similarly, *C. officinalis*-derived formulations containing phytosynthesized Ag or Zn-based nanostructures exhibited antimicrobial and antifungal properties, together with selective modulation of seed germination and early root development [3]. These results indicate that the plant extracts act not only as sources of biologically active compounds, but also as functional components in the generation and stabilization of nanostructured systems with combined biological effects.

Conclusions: Medicinal plant residues can be converted into value-added agricultural formulations combining bioactive plant compounds with green-synthesized nanostructures. The proposed approach integrates biomass valorization, green chemistry and nanotechnology and offers a versatile platform for crop support and plant protection within a circular bioeconomy framework.

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CHEMICAL CHARACTERIZATION AND BIOACTIVE PROPERTIES OF LAVENDER ESSENTIAL OIL AND INFUSIONS

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Keywords: Lavender essential oil; bioactive compounds; phytochemical properties; FTIR; HPLC-DAD; GC-MS; UV-VIS

Introduction: Lavender (*Lavandula latifolia*) is an aromatic plant widely used in pharmaceutical, cosmetic and food applications due to its diverse chemical composition and biological properties[1,2]. The composition of lavender extracts can be influenced by processing conditions such as particle size and infusion time, which may affect the extraction efficiency and consequently their biological activity[2]. The aim of this study was to characterize lavender essential oil obtained from a local producer and to investigate the effects of flower grinding and infusion time on the chemical composition and bioactive properties of aqueous infusions.

Materials and methods: Commercial lavender essential oil and dried lavender flowers were obtained from a local producer. The essential oil was analyzed by GC-MS, ICP-OES, while the obtained aqueous infusions were evaluated for total phenolic content (TPC), total flavonoid content (TFC), antioxidant activity, antimicrobial activity, phenolic acid profile by HPLC, FTIR analysis and ICP-OES.

Results: The GC-MS analysis of the essential oil revealed a complex volatile profile, with several tens of identified compounds, highlighting the chemical diversity of the lavender-derived product. For the aqueous infusions, both flower grinding and infusion time were considered as factors potentially affecting the extraction of bioactive compounds. The HPLC analysis demonstrated the presence of several phenolic acids. Differences in TPC, TFC, antioxidant and antimicrobial activities among the extraction conditions allowed the influence of the preparation procedure on the obtained infusions to be assessed. ICP-OES, GC-MS and FTIR analyses provided additional information on the elemental composition and the volatile constituents of the lavender-derived products.

Conclusions: The study investigated the chemical composition and bioactive properties of lavender essential oil and aqueous infusions. GC-MS analysis revealed a complex profile of volatile compounds in the essential oil, while HPLC analysis identified several phenolic acids in the infusions. The results were generally consistent with literature data on the chemical composition and bioactive properties of lavender extracts[3,4].

The results revealed differences in the properties of the infusions depending on the preparation of the plant material and the infusion time.

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OPTIMIZATION OF HOT-AIR DRYING OF BEE POLLEN FOR PRODUCT STABILITY AND NUTRITIONAL QUALITY

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Keywords: bee pollen, hot-air drying, moisture; water activity, nutritional quality

Introduction: Bee pollen is a valuable natural product rich in proteins, essential amino acids, vitamins, minerals, carotenoids and phenolic compounds, which contribute to its nutritional and functional potential [1,2]. The relatively high moisture content of fresh pollen may compromise its stability during storage, making appropriate preservation methods necessary [3]. Hot-air drying reduces moisture content and water activity, but temperature influences both drying efficiency and the retention of heat-sensitive bioactive compounds, including carotenoids [3,4]. Thus, optimization of drying parameters is essential to balance process efficiency, product stability and nutritional quality. This study evaluated the effects of hot-air drying at 35, 40 and 42°C on the physicochemical and nutritional characteristics of bee pollen to identify suitable processing conditions.
Materials and methods: Bee pollen with an initial moisture content of 28.41% (w/w) was subjected to hot-air drying at three temperatures (35, 40, and 42°C), using an air velocity of 3 m/s. The physicochemical characteristics of fresh and dried pollen were evaluated by determining moisture content, water activity, pH, ash content, and nutritional composition. Total protein content was determined using the Kjeldahl digestion method, β-carotene was quantified by high-performance liquid chromatography (HPLC), and vitamin C content was assessed using a volumetric titration method.
Results: Hot-air drying reduced the moisture content of bee pollen from an initial value of 28.41% to 10.40%, 8.01%, and 7.98% at drying temperatures of 35, 40, and 42°C, respectively. Water activity decreased from 0.718 in fresh pollen to 0.273, 0.211, and 0.196, respectively, indicating improved potential storage stability. Increasing the drying temperature from 35 to 42°C shortened the drying time by approximately 25%, while pH remained relatively stable, ranging from 4.41 to 4.43 in dried samples.
Regarding nutritional composition, total protein content increased from 17.4% in fresh pollen to 19.9%, 20.2%, and 19.5% at 35, 40, and 42°C, respectively. Vitamin C content gradually decreased from 0.58% in fresh pollen to 0.57%, 0.54%, and 0.51% after drying. Carotene content was considerably lower in dried samples (18.3–18.4 mg/kg) compared with fresh pollen (91.1 mg/kg).
Conclusions: Hot-air drying effectively reduced the moisture content and water activity of bee pollen, improving its potential storage stability. Among the investigated temperatures, 40°C, at an air velocity of 3 m/s and a drying time of 300 minutes, was identified as the most suitable processing condition. This temperature provided a favorable balance between drying efficiency, moisture reduction, and nutritional quality, while limiting the additional losses of heat-sensitive compounds observed at higher temperatures. The results support the application of controlled hot-air drying as an effective preservation method for bee pollen.

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PHYTOCHEMICAL CHARACTERIZATION AND BIOACTIVE PROPERTIES OF *TRAGOPOGON PRATENSIS* EXTRACTS OBTAINED USING DIFFERENT EXTRACTION METHODS

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Keywords: phytochemical characterizationl; antioxidant and antimicrobial activity; HPLC-DAD; FTIR; GC-MS

Introduction: *Tragopogon pratensis* has traditionally been used for its potential beneficial effects on liver and gallbladder function, digestion and appetite stimulation [1-3]. Its roots are also associated with astringent, diuretic, depurative and expectorant properties, while its high inulin content has been linked to potential benefits in glucose metabolism. The efficiency of extracting bioactive compounds depends on the extraction technique and the polarity of the solvent, which may affect the phytochemical profile and biological activity of the resulting extracts[4,5]. The aim of this study was to investigate the chemical composition and bioactive properties of *T. pratensis* extracts obtained using different extraction methods and solvent systems.

Materials and methods:

Tragopogon pratensis flowers were collected and subjected to maceration and ultrasound-assisted extraction for 2 h using hydroethanolic solvents of different concentrations, as well aqueous infusion. The obtained extracts were evaluated for total phenolic content (TPC), total flavonoid content (TFC), antioxidant activity and antimicrobial activity. The phenolic acid profile of the extract showing the most promising results in the preliminary analyses was determined by HPLC-DAD, while GC-MS and FTIR were used to further characterize its chemical composition. Additionally, ICP-OES was employed to determine the elemental composition of both the plant material and the extract.

Results: The different extraction procedures and solvent systems enabled the investigation of their influence on the phytochemical composition and antimicrobial activity of *T. pratensis* extracts. The HPLC-DAD analysis provided information on the phenolic acid profile, while GC-MS and FTIR analyses revealed several chemical constituents. Differences in TPC, TFC, antioxidant and antimicrobial activities among the extracts allowed the effects of extraction conditions on the recovery of bioactive compounds to be assessed. ICP-OES analysis provided additional information on the elemental composition of the plant material and the chosen extract, contributing to their complementary chemical characterization.

Conclusions: This study provided a characterization of *T. pratensis* through the assessment of its phytochemical composition, antimicrobial activity and elemental profile. These findings contribute to the chemical characterization of this species and provide a basis for further research into its potential as a source of bioactive compounds.

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SECTION 3 - Promoting climate neutrality and resilience through agriculture (Special section)

SOIL ORGANIC MATTER AS A FUNCTIONAL INTEGRATOR OF FERTILITY, PLANT NUTRITION AND AGROECOSYSTEM RESILIENCE

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Keywords: soil organic matter; functional carbon pools; soil fertility; plant nutrition; agroecosystem resilience

Introduction: Soil organic matter (SOM) is commonly reported as a single carbon stock, although its agronomic functions arise from interactions among particulate organic matter, mineral-associated organic matter, microbial biomass, aggregates and the soil solution. This review examines how these functional pools integrate physical, chemical and biological fertility, regulate plant nutrient acquisition and influence agroecosystem responses to hydroclimatic stress. It also evaluates management options that rebuild SOM while improving nutrient-use efficiency [1,2].

Materials and methods: An integrative narrative review was conducted using literature published predominantly during 2012-2026, prioritising indexed reviews, meta-analyses and experimental studies. Evidence was organised into four domains: soil physical properties and water relations; nutrient retention, transformation and availability; microbial functions; and management under climate stress. Studies were compared mechanistically without statistical pooling, while retaining differences among soils, crops, climates and intervention periods.

Results: The synthesis showed that SOM supports aggregate formation, pore continuity, water retention and lower susceptibility to compaction and erosion, thereby improving root exploration and nutrient transport. Organic exchange sites and functional groups also increase cation retention and pH buffering and regulate mineralisation, immobilisation, adsorption and complexation of N, P, S and micronutrients. Particulate fractions mainly support microbial energy supply and relatively rapid nutrient turnover, whereas mineral-associated fractions contribute more strongly to long-term carbon persistence; microbial products connect decomposition with stabilisation [1-3]. Consequently, total organic carbon alone cannot describe soil fertility. Management effects were strongly context dependent. Compost, manure, digestate, cover crops, reduced tillage and biochar can improve complementary SOM functions, but responses vary with feedstock quality, C:N ratio, dose, soil texture and mineralogy, pH, moisture-temperature regime and duration. Biochar performance is particularly dependent on production conditions and soil properties [4]. The most defensible strategy combines well-characterised organic inputs with mineral fertilisation, crop demand and soil testing, and evaluates outcomes using functional carbon fractions, biological indicators, hydrophysical properties, nutrient balances and environmental risks [3,5].

Conclusions: SOM should be managed as a dynamic biogeochemical system rather than as a single carbon target. Effective management must synchronise carbon inputs, microbial transformation, organo-mineral stabilisation and nutrient release with plant demand while limiting nutrient losses. A multi-indicator, site-specific framework offers a stronger basis for restoring fertility, increasing nutrient-use efficiency and improving resilience to drought, rewetting and temperature extremes.

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CHARACTERIZATION AND AGRICULTURAL APPLICATION OF SOIL-ISOLATED *AZOTOBACTER SPP.* AS SUSTAINABLE BIOFERTILIZERS

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Keywords: Azotobacter; biofertilizers; plant growth-promoting bacteria (PGPB); soil fertility; regenerative agriculture

Introduction: The excessive application of nitrogen-based chemical fertilizers in modern agriculture contributes significantly to environmental degradation, including greenhouse gas emissions, soil acidification, and biodiversity loss. Plant growth-promoting bacteria (PGPB) offer a sustainable alternative by enhancing nutrient availability and improving soil health. This study investigated the agricultural potential of soil-derived Azotobacter spp. as biofertilizers through the evaluation of their physiological characteristics, effects on tomato plant development, and influence on soil fertility parameters.
Materials and methods: Several Azotobacter strains were isolated from different soil samples and subjected to morphological and metabolic characterization. Strains exhibiting superior growth performance were selected for greenhouse experiments. Their capacity to promote tomato (*Solanum lycopersicum)* growth was assessed through germination, vegetative development, chlorophyll content, and biomass measurements. Changes in soil physicochemical properties and nutrient availability were also evaluated before and after cultivation.
Results: The isolated strains displayed characteristic morphological features of the genus Azotobacter and exhibited broad metabolic versatility, particularly regarding carbohydrate utilization. Three strains showed significantly higher biomass production, indicating strong suitability for biofertilizer development. Inoculation with these strains enhanced seed germination, accelerated leaf emergence, increased chlorophyll content, and promoted greater leaf biomass accumulation compared to uninoculated controls. These effects were associated with the strains' ability to enrich the rhizosphere with biologically available nitrogen. Additionally, treated soils showed improved levels of plant-assimilable nutrients and enhanced fertility indicators following cultivation.
Conclusions: The studied Azotobacter strains demonstrated considerable potential as sustainable biofertilizers by simultaneously improving plant performance and soil quality. Their application may contribute to reducing dependence on synthetic fertilizers while supporting environmentally friendly farming practices. These findings highlight the role of Azotobacter spp. as valuable microbial resources for regenerative and circular agriculture systems.

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UNLOCKING THE METHANE POTENTIAL OF COFFEE GROUNDS AND PLANT RESIDUES THROUGH ANAEROBIC CO-DIGESTION

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Keywords: spent coffee grounds, anaerobic digestion, biogas, biomethane, organic waste valorization

Introduction: Spent coffee grounds (SCGs) represent an abundant organic residue with potential for renewable energy recovery through anaerobic digestion.[1] This study investigates the use of SCGs obtained as a by-product of espresso beverage preparation from *100% coffea arabica of Uganda Bugisu* origin, medium-light roasted and extracted at 9 bar using a pulsed water extraction process (P.E.P.), as a substrate for anaerobic co-digestion with mixed vegetable residues. The objective of this study is to determine the influence of substrate composition by varying the SCG addition, inoculum percentage, and moisture content on anaerobic digestion and the composition of the resulting biogas.

Materials and methods: SCGs were used without prior drying. Vegetable residues consisting of carrot peels, potato peels and cabbage stalks in the form of thin, vermicelli-like strands obtained by shredding were mixed at a 1:1:1 ratio. The substrates were characterized in terms of moisture content, TS, VS and C/N ratio. A Box–Behnken Design of Experiments (DOE) comprising 15 experimental runs was applied, varying SCG proportion (0–20%), S/X ratio[2] (30/70–50/50) and S/L ratio (10/90–30/70). Batch reactors (500 mL, 400 mL working volume) were operated at 37 °C with agitation, using activated sludge from a wastewater treatment plant as inoculum. Biogas volume was measured and its composition was subsequently analysed by GC-TCD using helium as carrier gas.

Results: The use of DOE in conducting the experiment aimed to identify an optimal substrate composition incorporating spent coffee grounds in order to obtain biogas with a high methane content without having to perform numerous experiments that could lead to unfeasible extremes. CH_4 and CO_2 concentrations determined by GC-TCD will be used to assess the energetic potential of the produced biogas and to identify the experimental conditions associated with improved process performance.

Conclusions: The study provides an experimental assessment of SCGs from *Uganda Bugisu Arabica coffee* as a substrate for anaerobic co-digestion with vegetable residues. The combination of substrate characterization, experimental design and biogas analysis is expected to support the identification of suitable conditions for the conversion of these organic residues into biogas.

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COUPLED CARBON–NITROGEN ENZYME ACTIVITIES AND NUTRIENT POOLS IN A RECENTLY FERTILISED AGRICULTURAL SOIL (MOARA DOMNEASCĂ, ROMANIA)

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Keywords: soil enzymes; microbial biomass carbon; nitrite; mineral fertilisation; climate-neutral agriculture

Introduction: Arable soils control whether carbon (C) and nitrogen (N) are recycled, stored or lost, and mineral fertilisation can shift this balance within days. Nitrogen inputs tend to reduce soil microbial biomass [1], particularly in acidic soils [2], while transient nitrite accumulation is a known precursor of N_2O [3]. Soil enzymes respond rapidly to such changes and are sensitive indicators of soil functioning. Within the effort towards climate-neutral and resilient agriculture, we aimed to provide a coupled C–N baseline of an arable soil shortly after NP fertilisation, linking nutrient pools, microbial biomass and enzyme activities under two crops, as a reference for greenhouse-gas and soil-carbon studies in Romanian agroecosystems.

Materials and methods: Composite topsoil samples (0–20 cm; n = 5 per plot) were collected in April 2026 at the Moara Domnească experimental farm (Ilfov county) from sunflower, maize and a nominal control plot, about two weeks after mechanical application of 180 kg ha^{-1} NP 20:20:0. We determined pH, moisture, organic matter, inorganic N (NH_4^+, NO_2^-, NO_3^-) and PO_4^{3-}, extractable organic C and microbial biomass C (fumigation–extraction), and the activities of urease, nitrate reductase, β-glucosidase (BG) and β-glucosaminidase (NAG) by spectrophotometric assays; all results are expressed per gram dry weight (gdw). Data were analysed by Kruskal–Wallis tests, Spearman correlations and principal component analysis (PCA).

Results: The soil was acidic (pH 4.8–6.7) and homogeneous in organic matter (5.6–6.9%) and extractable C. NH_4^+ was the dominant mineral N form, consistent with slow nitrification at low pH [4], and mineral N was lowest under sunflower (17.5 vs 32–33 µg N gdw^{-1}; $p = 0.026$). Microbial biomass C was ~32% lower under both crops than in the control (57–59 vs 84 µg C gdw^{-1}; $p = 0.036$), in line with biomass declines reported after mineral N addition, especially in soils with pH ≤ 5 [1, 2]. NO_2^- was highest under maize ($p = 0.009$) and tended to increase with pH, consistent with free-ammonia inhibition of nitrite oxidisers [3], whereas nitrate reductase activity was highest under sunflower and correlated negatively with NO_3^- ($\rho = -0.75$) and NH_4^+ ($\rho = -0.72$). NO_3^- and PO_4^{3-} co-varied ($\rho = 0.61$), revealing a patchy fertiliser footprint and spill-over into the control. Urease activity did not differ among plots but increased with organic matter ($\rho = 0.60$). β-glucosidase was highest under maize, plausibly reflecting cellulose-rich crop residues, and BG:NAG ratios above 3 in all plots (4.4 under maize) indicated greater microbial investment in C than N acquisition [5]. PCA separated the control from the sunflower plot along PC1 (29% of variance; $p = 0.008$).

Conclusions: Two weeks after fertilisation, biological indicators (microbial biomass, nitrite, nitrate reductase) responded more strongly than bulk soil properties, pointing to reduced microbial biomass, potential N_2O-producing pathways and C-limited microbial communities. Uneven mechanical spreading also created nutrient hotspots, with implications for nutrient-use efficiency and diffuse pollution. Seasonal monitoring against an isolated unfertilised reference, coupled with in-situ greenhouse-gas flux measurements, is needed to translate these indicators into climate-smart fertilisation practices.

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CLOSING THE LOOP THROUGH CHEMISTRY: BIORESOURCE-BASED SOLUTIONS FOR CLIMATE-RESILIENT AGRICULTURE

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Keywords: circular bioeconomy; biomass valorization; green chemistry; functional materials; climate resilience

Introduction: The transition towards climate-neutral and resilient agriculture requires solutions that connect renewable resource valorization with efficient agricultural production and environmental protection. Beyond replacing conventional raw materials, agricultural biomass and side-streams can provide functional components for technologies addressing resource use and pollution. This narrative review examines how green chemistry and materials science can support this transition, with emphasis on the relationship between resource origin, processing, technological function and environmental performance.
Materials and methods: The review adopts a thematic approach to selected literature on biomass-derived functional materials and agricultural applications. Three complementary directions are considered: conversion of agricultural side-streams into useful components, development of materials supporting nutrient management, and integration of bioresource-based solutions into environmental technologies. These directions are discussed in relation to the publicly described research priorities of the AgroCliN Centre of Excellence.
Results: The literature illustrates [1-3] the potential of assigning specific technological functions to biomass-derived components. Cellulose-based carriers, for example, have been investigated for controlled nutrient delivery, connecting residue valorization with agricultural functionality. However, renewable origin alone does not establish environmental superiority. Processing requirements, material stability, biological safety and end-of-life behavior must also inform technology selection. A central challenge is to connect laboratory performance with evidence of practical benefit under relevant conditions. The review therefore highlights the need to distinguish resource circularity, agricultural effectiveness and climate impact when evaluating emerging solutions.
Conclusions: Chemistry-driven bioresource valorization offers a framework for linking circular bioeconomy with agricultural innovation. Progress depends on selecting resources according to their intended function and evaluating the resulting technologies across their life cycle. Integrating material development, environmental assessment and application-level validation can help identify solutions with credible potential to support climate resilience and contribute to climate-neutral agricultural systems. Expertise gained in developing materials and processes for environmental protection can further support this transition through its transfer and adaptation to agricultural applications.

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EARTH OBSERVATION SERVICES FOR CLIMATE-NEUTRAL AND RESILIENT AGRICULTURE: THE AgroCliN WP5 MULTISCALE REMOTE SENSING FRAMEWORK

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Keywords: Earth Observation; remote sensing; precision agriculture; soil organic carbon; climate neutrality

Introduction: Climate change is intensifying drought, water stress and soil degradation across Romanian agriculture, undermining productivity and the transition of the sector towards climate neutrality [1]. AgroCliN - the Excellence Research Centre Fostering Climate Neutrality and Resilience through Agriculture (2026-2030), coordinated by USAMV Bucharest together with five partner institutions - addresses this challenge through interdisciplinary research linking bioresources, soil, water and digital technologies. This contribution presents the design of Work Package 5 (WP5), which develops an integrative Earth Observation (EO) service framework with three objectives: (i) monitoring crop health and optimizing water use through EO; (ii) integrating IoT sensor networks with EO for precision agriculture; and (iii) developing the AgroCliN data-driven platform for integrated data access and decision support.

Materials and methods: The methodology spans six interconnected tasks. Crop phenology, water management and drought monitoring rely on Sentinel-1 SAR, Sentinel-2 optical [2] and Unmanned Aerial System (UAS) data, through spectral vegetation indices and crop-growth models. Precision nitrogen management integrates Sentinel-2 multispectral, EnMAP [3] and PRISMA hyperspectral, and Pléiades Neo very-high-resolution (VHR) imagery to derive Nitrogen Nutrition Index estimates [4]. Soil organic carbon (SOC) is estimated from multispectral, hyperspectral and radar time series, refined with VHR and hyperspectral UAS imagery. Early detection of crop diseases and pests exploits spectral disease indices [5] derived from multi-season UAS hyperspectral data. Crop yield estimation merges classified EO products with in-situ measurements through geospatial and machine-learning modelling. EO-derived products are cross-checked at two experimental pilot sites against continuous IoT soil and weather monitoring and laboratory analyses of crop, soil and water samples.

Results: The principal outcome reported here is the scientific design and data architecture of the framework. Five EO service lines - water and drought, nitrogen, soil organic carbon, phytosanitary status and yield - are defined on a common multiscale data chain (satellite - UAS - IoT - laboratory) and feed a Decision Support System embedded in the AgroCliN platform, designed with user-centred interfaces and clear visualizations for farmers. Machine-learning algorithms progressively integrate the outcomes across tasks to improve estimation accuracy, while the laboratory analyses provide the chemical reference data needed for calibration and validation of the spectral models.

Conclusions: By translating heterogeneous multiscale observations into actionable agronomic services, WP5 is expected to deliver validated tools for water, nitrogen, carbon, phytosanitary and yield management, contributing to reduced agricultural inputs, enhanced soil carbon sequestration and the broader transition of Romanian agriculture towards climate neutrality and resilience.

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BASELINE SOIL CHARACTERIZATION IN THE AGROCLIN EXPERIMENTAL PLATFORM: A BASIS FOR ASSESSING CARBON SEQUESTRATION AND AGRICULTURAL RESILIENCE

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Keywords: soil baseline; soil organic carbon; soil microbiome; resilient agriculture; climate neutrality

Introduction: Protection and integrated monitoring of soil resources are essential components of the transition towards resilient and climate-neutral agriculture, in line with European objectives for soil health and climate neutrality [1,2]. In this context, the AgroCliN experimental platform at the Moara Domneasca Agronomic Research and Development Station (Vlasia Plain, within the forest-steppe transition zone) was established for the long-term assessment of agricultural practices on soil properties, carbon dynamics and biological functioning. The objective of this initial stage was to establish an integrated baseline (T0), prior to the differentiated application of tillage and fertilization systems, so that subsequent changes can be attributed to the experimental management practices.
Materials and methods: The platform covers 6.8 ha and tests four technological variants resulting from the combination of two tillage systems (conventional and minimum tillage) and two fertilization strategies (mineral and compost + mineral). The experiment is organized in three replicate blocks, each comprising three crop rotation fields, with the four variants allocated to plots of 1,680 m² (24 × 70 m) within each field, totaling 36 plots. The plots were delineated using GNSS measurements, and the data were integrated into a GIS to generate the digital terrain model. Four representative soil profiles were described to validate the soil unit. T0 sampling was performed in all three replicate blocks, at depths of 0–20 cm and 20–40 cm, using disturbed and undisturbed samples, according to the ICPA methodology [3]. Composite samples consisted of 8–10 subsamples; separate samples were collected for bulk density, aggregate stability, biological indicators and microbiome analysis, with microbiome samples maintained under refrigerated conditions. In situ measurements of infiltration and penetration resistance were also performed.
Results: The geometric design of the platform, field staking, GIS database, digital terrain model and the complete T0 sampling campaign were finalized. Morphological description of the soil profiles confirmed the presence of the zonal soil, classified as a Luvisol (Preluvosol, reddish subtype) developed on loess-like deposits. The analytical program designed for the T0 sample set targets the initial status of soil fertility and structure, organic carbon and microbial functioning. The biological component includes basal respiration, microbial biomass carbon [4] and the structure of bacterial and fungal communities assessed by 16S rRNA gene and ITS amplicon sequencing. Integration of these datasets allow estimation of the initial soil organic carbon stock and definition of a common "zero matrix" for monitoring carbon sequestration, microbiological changes and soil responses to the agricultural practices tested within AgroCliN.
Conclusions: Rigorous characterization of the T0 status provides the reference required for comparable long-term assessment of agricultural management effects on soil carbon, physicochemical properties and biological resilience. By integrating pedological, GIS and microbiological data, the AgroCliN platform establishes the methodological basis for quantifying changes induced by agricultural technologies and evaluating their contribution to climate neutrality and soil health.

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EXPLORING A NEW APPROACH FOR RAPID ASSESSMENT OF SOIL MICROBIAL BIOMASS THROUGH SUBSTRATE INDUCED RESPIRATION

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Keywords: soil, microbial biomass, respiration, MicroResp™

Introduction: Soil microbial biomass comprises the living microbial component of soil organic matter and represents one of its most dynamic and biologically active fractions. It plays a key role in soil functioning, acting as both a sink and a source of plant nutrients and contributing to soil organic matter decomposition and nutrient cycling. Several methods are available for estimating soil microbial biomass, among which substrate-induced respiration (Anderson and Domsch, 1978) is widely used due to its simplicity, rapidity and low cost. Based on the same principle of substrate-induced respiratory response, we adapted the MicroResp™ method (Campbell et al., 2003) for the rapid assessment of microbial biomass in agricultural soils. The aim of the present study was to assess whether the MicroResp™ method could be used for the rapid estimation of soil microbial biomass.
Materials and methods: Two agricultural soils subjected to different management practices were incubated following an adapted MicroResp™ protocol. Soil samples were amended with glucose to determine the substrate-induced respiratory response. Glucose was used as a readily available universal substrate and the maximum initial respiratory response was used as a proxy for microbial biomass. Soil samples were incubated at 25°C and CO_2-C production was quantified by measuring the absorbance of the MicroResp™ detection plates after 2, 4, and 6 h of incubation. The respiratory response to increasing glucose concentrations and its dynamics during incubation were used to identify the conditions providing the maximum initial substrate-induced respiration for estimating soil microbial biomass.
Results: The results showed a rapid respiratory response following glucose addition, with the highest CO_2-C production observed at 6 hours after starting point. The response became clearly detectable after 2 h of incubation and increased after 4 and 6 hour of incubation. During the experiment, repeated opening and reading of the same MicroResp™ detection plates appeared to affect the reliability of the measurements. Therefore, based on the observed respiratory response, a glucose concentration of 8000 ppm and an incubation time of 6 h are recommended for microbial biomass estimation. The use of separate detection plates for each incubation time is also recommended to avoid disturbance associated with repeated measurements.
Conclusions: The adapted MicroResp™ approach showed promising potential for the rapid estimation of soil microbial biomass. However, further methodological refinement and validation against established methods are required before its routine application.

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COVER CROPS FOR RESILIENT AGRICULTURE: BENEFITS, RISKS AND MANAGEMENT

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Keywords: cover crops; soil fertility; crop productivity; resilient agriculture

Introduction: Agricultural intensification has increased productivity but has also promoted soil erosion, compaction, organic matter loss and declining soil fertility. Keeping soil bare between two main crops increases surface runoff and the loss of water and nutrients [1]. Cover crops are therefore an important component of sustainable agriculture, contributing to soil protection, nutrient recycling, increased organic matter inputs and weed suppression [2–4]. Their effects depend on the species, biomass production, sowing and termination dates, and pedoclimatic conditions. In Romania, cover crops are promoted through intervention DR-02 of the CAP Strategic Plan 2023–2027. This study integrates international evidence to support the design of an experimental framework for assessing cover crop benefits and identifying research directions suitable for resilient agriculture.
Materials and methods: A literature review was conducted using international review papers, experimental studies and research articles, together with the regulatory documents of the CAP Strategic Plan 2023–2027. The study synthesizes findings on the effects of cover crops on soil protection, nutrient cycling, soil organic carbon, water dynamics, weed suppression and the productivity of the subsequent main crop.
Results: The main findings of the reviewed studies are summarized in Figure 1. Results from experiments conducted in Romania were considered together with international reviews to interpret the effects of cover crops on crop productivity, nitrogen dynamics and soil organic carbon.

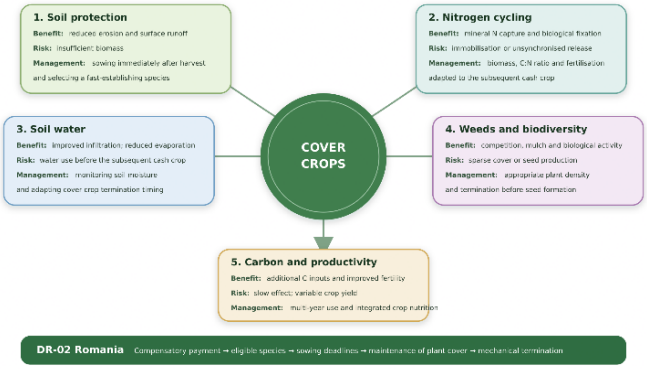


Figure 1. Benefits, risks and management of cover crops (authors' elaboration based on the literature).

Conclusions: The literature review indicates that cover crops can protect soil against erosion, reduce nitrogen losses, increase organic matter inputs, conserve water and suppress weeds. However, their effects are not uniform and depend on the species or mixture used, biomass production, residue C:N ratio, sowing and termination dates, water availability and fertilization of the subsequent crop. Species selection and management must therefore be adapted to local pedoclimatic conditions and farm objectives. Support provided through intervention DR-02 may facilitate the wider adoption of these practices in Romania. Nevertheless, research under Romanian conditions remains insufficient, highlighting the need for more detailed, multi-year studies conducted across different agricultural regions.

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POROUS HYDROXYAPATITE SYNTHESIS VIA CTAB FOR LEAD ION ADSORPTION

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Keywords: hydroxyapatite, cetyltrimethylammonium bromide, water remediation, lead ions removal,

Introduction: Heavy metal contamination of water, particularly by toxic lead (Pb^{2+}) ions, possess a critical global threat to both ecosystems and human health [1]. In the last years, hydroxyapatite (HAp) has gained considerable attention as an eco-friendly adsorbent due to its exceptional properties [2-4]. To overcome the limitations of low surface area in conventional bioceramics, synthesis using surfactants such as cetyltrimethylammonium bromide (CTAB) could offer an effective route to obtain porous materials with numerous active surface sites, thereby significantly enhancing lead adsorption capacity [1,3]. In this study, a simple, adapted co-precipitation method was used to synthesize a low-cost bioceramic nanocomposite based on porous hydroxyapatite (HAp) and the surfactant cetyltrimethylammonium bromide (CTAB). The resulting material was analyzed using Fourier-transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). Batch adsorption experiments and atomic absorption spectrometry (AAS) were also performed to demonstrate the efficient Pb^{2+} removal from aqueous solutions.

Materials and methods: The HAp-CB composite (Ca/P molar ratio of 1.67) was obtained by adding a phosphate solution to the Ca-CTAB solution under vigorous stirring. Specifically, $Ca(NO_3)_2 \cdot 4H_2O$ and CTAB (9 g) were dissolved in 300 mL of deionized water to obtain the Ca-CTAB solution, while $(NH_4)_2HPO_4$ was dissolved in 300 mL of deionized water to form the phosphorus-containing solution. During the synthesis process, the pH was maintained at 10. The resulting precipitate was washed several times with deionized water and centrifuged. The resulting HAp-CB composite was dried at 100 °C for 24 hours. FTIR spectra were recorded on a PerkinElmer Spectrum BX spectrometer across 400-4000 cm^{-1} at 4 cm^{-1} resolution. The morphology of the HAp-CB nanocomposites was examined using scanning electron microscopy (SEM). Batch adsorption experiments were conducted at room temperature 25 ± 2 °C to evaluate the lead retention capacity of the HAp-CB [3]. The Pb^{2+} concentrations were determined in triplicate by Flame Atomic Absorption Spectrometry (AAS) at 283.3 nm.

Results: FTIR studies revealed the presence of phosphate groups specific to HAp structure and also the presence of quaternary ammonium bands characteristics to CTAB. The SEM analysis revealed that HAp-CB nanocomposite particles exhibit nanometric dimensions with a predominantly ellipsoidal morphology.The AAS results highlighted that the HAp-CB nanocomposites demonstrated a high Pb^{2+} ion removal efficiency and that the removal efficiency (R%) was strongly influenced by the initial Pb^{2+} concentration. The AAS findings showed that for lead concentrations higher than 10 mg/L the removal efficiency was higher than 98%.

Conclusions: FTIR analysis confirmed the presence of characteristic hydroxyapatite phosphate modes alongside CTAB quaternary ammonium groups. The morphological evaluation using SEM showed that the composite consists of nanoscale particles having ellipsoidal shape. The batch adsorption tests revealed that the removal efficiency was concentration-dependent and exceeded 99% for Pb^{2+} thus demonstrating that HAp-CB nanocomposites could be considered highly effective adsorbents for heavy-metal wastewater treatment.

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SYNTHESIS AND CHARACTERIZATION OF A HYDROXYAPATITE–SODIUM BICARBONATE BIOCOMPOSITE FOR LEAD REMOVAL FROM CONTAMINATED WATER

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Keywords: hydroxyapatite, sodium bicarbonate, environmental remediation, lead ions removal

Introduction: It is well known that lead (Pb^{2+}) is a toxic heavy metal frequently found in contaminated surface and groundwater [1]. Hydroxyapatite (HAp) a biocompatible calcium phosphate-based material has attracted researchers' attention due to its ability to interact with heavy metal ions and remove them from aqueous media [2]. In this context, functionalizing HAp with sodium bicarbonate represents a promising approach for obtaining materials with properties suitable for environmental applications. This study focuses on the development of a new hydroxyapatite and sodium bicarbonate-based biocomposite (HAp-BC) with potential applications in environmental remediation. The HAp-BC composite material was synthesized using a low-cost method and subsequently characterized in terms of its physico-chemical properties and efficiency in removing lead ions from aqueous solutions.

Materials and methods: $(NH_4)_2HPO_4$, $Ca(NO_3)_2 \cdot 4H_2O$, and $NaHCO_3$ were used to develop the new HAp-BC composite material, in accordance with previous studies [3]. The synthesis was carried out at ambient temperature. The Ca/P molar ratio was 1.67. XRD measurements were performed using a Bruker D8 Advance diffractometer. Data were recorded using nickel-filtered CuKα radiation. The powder morphology was analyzed using a Hitachi S4500 scanning electron microscope.ATR-FTIR studies were conducted using a Perkin Elmer SP-100 spectrometer [3]. The efficiency of Pb^{2+} ion removal from contaminated water was evaluated through batch adsorption experiments, conducted according to the protocol previously described [4].

Results: XRD studies revealed a material with good crystallinity that preserves the structure of pure HAp. FTIR data confirmed the presence of phosphate groups from the HAp structure in the sample. SEM analysis revealed that HAp-BC consists predominantly of particles with a nearly spherical morphology and a pronounced tendency to agglomerate. The HAp-BC sample demonstrated high Pb^{2+} ion removal efficiency exceeding 85% across all investigated initial concentrations.Batch adsorption experiments demonstrated that HAp-BC composite exhibited a strong affinity for Pb^{2+} ions across all tested concentrations, achieving removal efficiencies consistently above 85%. The removal percentage depended on the initial Pb^{2+} concentration, surpassed approximately 93% when the initial metal concentration exceeded 50 mg/L.

Conclusions: The presence of intense, well-defined reflections characteristic of the apatite structure in the diffraction spectrum of the HAp-BC powder confirms good crystallinity and the preservation of the pure HAp structure. The FTIR results confirmed the present of the functional group from HAp structure in the analyzed sample. SEM results provided information about the nanometric and spherical morphology of the particles. The results of the batch adsorption experiments highlighted that HAp-BC composites demonstrated a high affinity for aqueous Pb^{2+}, achieving a removal efficiency exceeding 85% that reached 99% at higher initial concentrations, thus confirming their potential use as highly effective adsorbents for wastewater remediation.

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FROM MOLECULAR RECOGNITION TO WATER REMEDIATION: ENVIRONMENTAL PERSPECTIVES OF FLUORESCENT SCHIFF-BASE SYSTEMS

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Keywords: Schiff bases; fluorescence; metal complexes; water treatment; environmental remediation.

Introduction: Schiff bases combine structural versatility, strong metal-coordination ability and readily tunable optical properties, making them attractive beyond their extensively investigated biomedical applications. Their fluorescence response to coordination processes can provide a basis for metal-ion recognition, while the incorporation of redox-active metal centers can generate catalytic functionalities relevant to the transformation of organic contaminants. The present work explores this complementary environmental perspective, with emphasis on the possible integration of fluorescent Schiff-base systems into water monitoring and treatment platforms [1,2].

Materials and methods: Fluorescent Schiff-base ligands and their metal complexes were considered within an application-oriented design framework addressing coordination behaviour, optical response, redox properties and stability under aqueous conditions. Particular attention was given to structural characteristics that may support selective interaction with dissolved metal ions and to metal centres capable of promoting light-assisted or redox-mediated processes. The potential immobilization of these molecular systems on porous, mineral or polymeric supports was also considered as a route toward heterogeneous materials compatible with adsorptive and catalytic water-treatment processes.

Results: The analysis highlights two complementary functions of Schiff-base platforms in aqueous systems. The ligand structure can be tailored to generate measurable fluorescence changes following interaction with selected metal ions, providing opportunities for rapid screening or monitoring of contaminated waters [1]. Following metal coordination, the resulting complexes can acquire additional redox and photoresponsive properties that are potentially useful for catalytic degradation of organic pollutants [2]. From a water-treatment perspective, first-row transition-metal systems are particularly attractive because coordination chemistry, optical response and redox activity can be adjusted through ligand design. Their immobilization on suitable supports may additionally improve recovery, limit material dispersion into the treated water and facilitate integration with adsorption or photocatalytic treatment stages. Thus, molecular recognition and pollutant removal can be regarded as complementary directions rather than independent applications of the same ligand platform.

Conclusions: Fluorescent Schiff-base systems provide a versatile molecular toolbox that can be extended from classical coordination and biomedical chemistry toward environmental technologies. Rational control of ligand structure and metal coordination offers opportunities for combining pollutant recognition with catalytic functionality, while immobilization on functional supports could enable their incorporation into reusable water-treatment materials. This approach creates a conceptual link between molecular sensing, adsorption and advanced degradation processes and supports the development of multifunctional platforms for monitoring and treating waters with complex contamination profiles.

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BIOTESTS FOR ASSESING ABIOTIC STRESS: THE EFFECTS OF CADMIUM AND SODIUM CHLORIDES OVER MUNG BEANS SEEDLINGS TREATED WITH BIOSTIMULANTS

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Keywords: biotests, plant health, NDVI, Quantum Yield, biostimulants, biomass, fluorescence, antioxidant activity.

Introduction: Cadmium toxicity and salinity can impair plant growth, nutrient balance and photosynthetic performance, while promoting oxidative stress. Biostimulants may help plants tolerate these conditions, but evaluating their efficacy requires complementary measurements of growth, physiological function and biochemical responses. Biotests integrating these different measurements aims to distinguish early stress responses (through the appearance of reactive oxygen species, ROS) from subsequent growth effects and assess the potential of the biostimulant treatments.

Materials and methods: Among processes of plant health determination, biomass accumulation, plant height, SPAD, NDVI/NDRE and Quantum Yield were chosen for this study in comparison with ICP-OES determination of cadmium, sodium/other ions, fluorescence quantification of peroxynitrite on 5 mm leave disks of Mung Beans seedlings grown under controlled conditions and antioxidant activity, pigments and total phenolic content of the extracts of the same grown plants. ICP-OES was performed on different plant parts (leaves and roots) to observe the differences. NPK values were also studied. 12 different treatments were used to grow the Mung Beans seedlings in greenhouse, for a period of 4-5 weeks, using 3 different biostimulant formulations, in the absence and presence of cadmium/sodium chlorides stress. Each treatment has 10 replicates, and each replicate has 24 plants. For each characterization, the determination was performed in triplicates. The biological moments chosen for this study were 24 hours and 7 days after stress application, together with their controls without stress.

Results: The correlation between biomass accumulation (which is decreasing when the health of the plant is affected), photosynthetic capabilities (which also decrease in terms of both Quantum Yield and SPAD), are in accordance with fluorescent methods, antioxidant activity, total phenolic content and pigments (with decreasing chlorophyl levels). The results are discussed and correlated between each other accordingly.

Conclusions: Mung Beans seedlings grown in the absence and presence of cadmium/sodium chloride stress, treated with different biostimulant formulations, for studying redox signaling and efficacy of plant treatments are successfully assessed using the described biotests.

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ASSOCIATED EVENTS

TECH TALKS – MEET THE MENTORS!

The First Step in Technology Transfer: Industrial Property Protection
20 October 2026, PRIOCHEM XXII, ICECHIM Bucharest

An event organized in collaboration with the Romanian State Office for Inventions and Trademarks (OSIM)

Connecting Scientific Discovery with Innovation

Scientific research generates knowledge, new ideas, and technological solutions with the potential to address important economic, environmental, and societal challenges. However, transforming a research result into a successful innovation requires more than scientific excellence. It also involves identifying its practical potential, protecting the intellectual assets generated through research, and establishing effective pathways towards technology transfer.

Recognizing the importance of these challenges, the International Symposium PRIOCHEM has continued to develop its **Tech Talks – Meet the Mentors!** initiative, providing a dedicated platform for dialogue between researchers and professionals with expertise in innovation, intellectual property, and technology transfer.

The third edition of Tech Talks, organized during PRIOCHEM XXII in collaboration with the **Romanian State Office for Inventions and Trademarks (OSIM)**, focused on the theme *"The First Step in Technology Transfer: Industrial Property Protection."*

The initiative aimed to bring researchers, particularly doctoral students and early-career scientists, closer to the practical aspects of protecting their research results and understanding the role of industrial property rights in the innovation process. Unlike conventional scientific presentations, Tech Talks encourages direct interaction, practical discussions, and the exchange of professional experience, creating opportunities for participants to address questions that frequently arise during research activities but are not always covered by traditional academic training.

From Research Results to Protected Inventions

In academic and research environments, scientific publications remain among the most important indicators of research performance. Nevertheless, research activities may also generate novel materials, processes, formulations, devices, and technologies with considerable potential for industrial application. A major challenge is recognizing when a scientific result represents not only an opportunity for publication but also a potentially patentable invention.

The relationship between **scientific dissemination and intellectual property protection** is particularly important. While publishing research results is essential for scientific progress, premature public disclosure may compromise the novelty required for patent protection. Consequently, researchers need to understand when and how to assess the patentability of their results, how to approach prior-art investigations, and how to coordinate publication strategies with intellectual property protection procedures. These considerations become even more relevant in collaborative research projects involving universities, national research institutes, and industrial partners, where questions concerning invention ownership, confidentiality, and the exploitation of research outcomes may require careful management.

Industrial property protection should therefore not be regarded as an administrative procedure performed only after research has been completed. Instead, it should be integrated into research planning and innovation management, helping research organizations identify, protect, and valorise their technological developments. The Tech Talks initiative contributes to promoting this perspective by facilitating access to the experience of intellectual property specialists and encouraging researchers to consider the technological and economic potential of their scientific activities.

Meet the Mentors – OSIM Specialists

The 2026 edition brought together six specialists from OSIM, representing complementary areas of expertise in patent examination and industrial property communication:

- **Dr. Biochem. Irina Babaligea, Specialist Examiner, Chemistry and Pharmacy Examination Service**

- **Daniela-Idboio Dragomir, Expert, Industrial Property Communication and Promotion Department**
- **Eng. Luiza Modreanu, Specialist Examiner, Chemistry and Pharmacy Examination Service**
- **Mariana Hahue, Expert, Public Relation Department**
- **Eng. Marcela Pițu, Specialist Examiner, Chemistry and Pharmacy Examination Service**
- **Marina Voiculescu, Expert, Industrial Property Communication and Promotion Department**

Moderator: Dr. Habil. Radu Claudiu FIERĂSCU, President of the PRIOCHEM XXII Scientific Committee, ICECHIM Bucharest.

The participation of specialists directly involved in patent examination and industrial property promotion provided an opportunity to connect the scientific community with the institutions responsible for protecting inventions.

The discussions addressed industrial property protection, patent procedures, and the importance of intellectual property management in research organizations. The complementary expertise of the invited specialists helped connect the technical requirements of patent examination with the broader need for awareness, training, and effective communication concerning industrial property rights.

Encouraging an Innovation-Oriented Research Culture

Beyond the specific aspects of patent protection, Tech Talks reflects a broader objective: strengthening an innovation-oriented research culture in which scientific excellence, creativity, and technological valorisation are regarded as complementary components of research performance.

For young researchers, understanding intellectual property protection at an early stage can influence how they plan experiments, document results, collaborate with external partners, and communicate scientific findings. It can also encourage them to recognize the innovative potential of their work and to explore opportunities beyond traditional academic dissemination.

For research institutions, effective intellectual property management can contribute to building stronger relationships with industry, supporting licensing opportunities, facilitating technology transfer, and increasing the societal and economic impact of publicly funded research.

At the same time, patent protection is not an objective in itself. Its value depends on the technological relevance of the invention, its potential applications, and the existence of appropriate strategies for further development and exploitation. A successful innovation ecosystem therefore requires not only the generation and protection of inventions but also cooperation among researchers, technology transfer professionals, industrial partners, and public institutions.

Through initiatives such as Tech Talks, PRIOCHEM seeks to encourage this cooperation and contribute to bridging the gap between laboratory research and practical implementation.

Looking Beyond the Laboratory

The collaboration between ICECHIM Bucharest and OSIM during PRIOCHEM XXII also included the invited lecture *"Intellectual Property in Research: From the Laboratory to Patent Protection,"* delivered by OSIM representatives on 23 October 2026. Together, these activities reinforced the importance of integrating intellectual property awareness into the broader scientific and professional development of researchers.

By combining scientific exchange with practical discussions on innovation and technology transfer, PRIOCHEM continues to evolve beyond the traditional format of an academic symposium.

Tech Talks – Meet the Mentors! represents an important component of this approach, supporting a research community that is not only capable of producing valuable scientific knowledge but is also increasingly aware of the opportunities and responsibilities associated with protecting and transforming that knowledge into innovation.

Ultimately, the successful transfer of research results towards practical applications begins with understanding their value, recognizing their potential, and taking the appropriate steps to protect them.

Because a scientific discovery can become the starting point of an innovation, but transforming it into impact requires knowledge, collaboration, and a clear vision beyond the laboratory.

INTEGRATED APPROACH TO ENVIRONMENTAL PROTECTION – AQUAMAT

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Keywords: ***water remediation; advanced materials; pollutant detection; adsorption; advanced oxidation processes.***

The increasing complexity of water contamination requires integrated strategies capable of combining rapid pollutant detection with efficient removal technologies. The AquaMat project (PN 23.06.01.01) addresses this challenge through the development of advanced materials and complementary technologies for water monitoring and purification. The workshop presented the project's research directions and achievements, emphasizing the transition from individual functional materials towards integrated environmental protection solutions. The research combines miniaturized bioanalytical systems for pollutant screening with functional adsorbents, modified membranes, and advanced oxidation technologies. The approaches investigated include selective adsorption of inorganic and organic contaminants, photocatalytic degradation, catalytic ozonation, and membrane-assisted separation. Material synthesis and physicochemical characterization are complemented by analytical and functional evaluations targeting the removal or degradation of water pollutants.

Research activities conducted within AquaMat have addressed several complementary technological components, including biosensing platforms, adsorbent materials, functionalized membranes, photocatalytic systems, and catalytic ozonation processes. Their integration offers opportunities to combine the selectivity of adsorption and membrane separation with the destructive removal of organic contaminants through advanced oxidation. The workshop highlighted the importance of selecting compatible treatment stages, improving material stability, and evaluating the potential for further technological development.

AquaMat promotes an integrated approach to water protection, connecting pollutant detection, advanced material development, and complementary remediation technologies. The combination of these research directions provides a foundation for developing adaptable water-treatment systems and identifying opportunities for further interdisciplinary collaboration.

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INNOVATIVE APPROACH FOR THE PROTECTION OF MEDICINAL AND AROMATIC PLANT CROPS – BETWEEN CIRCULAR BIOECONOMY AND NANOTECHNOLOGY

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Keywords: ***medicinal plants; circular bioeconomy; green synthesis; nanostructures; crop protection.***

Sustainable cultivation of medicinal and aromatic plants requires innovative strategies that reduce dependence on conventional chemical treatments while improving resource efficiency. The BioEcoNan project (85PED/2025) proposes a circular approach in which plant residues are valorized to develop multifunctional formulations for protecting and supporting the cultivation of the same plant species. Plant residues originating from *Momordica charantia* L. and *Calendula officinalis* L. were investigated as sources of bioactive extracts and as reducing and stabilizing media for the green synthesis of metallic and metal oxide nanostructures. Hydroalcoholic extracts and phytosynthesized Ag-, Cu-, and Zn-based systems were characterized and evaluated for antimicrobial properties, inhibition of microbial adhesion and biofilm formation, and their effects on seed germination and early plant development.

The developed formulations exhibited multifunctional biological responses, combining antimicrobial activity with species-dependent effects on plant development. *M. charantia*-derived systems demonstrated selective effects on germination and root development, while Ag- and Cu-containing formulations maintained antimicrobial and antibiofilm properties. Formulations based on *C. officinalis* extracts and phytosynthesized nanostructures also exhibited antimicrobial and antifungal activities. These findings support the potential of plant residues as functional resources for developing crop-specific protection formulations.

BioEcoNan demonstrates the potential of integrating biomass valorization, natural bioactive compounds, and green nanotechnology into sustainable agricultural solutions. The proposed strategy provides a scientific basis for developing multifunctional formulations combining crop protection and biostimulant effects, while contributing to circular bioeconomy principles.

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TRANSDISCIPLINARY APPROACH FOR THE MODERN FORMULATION OF CONSTRUCTION MATERIALS, A PARADIGM SHIFT IN THE PROTECTION OF IMMOVABLE CULTURAL HERITAGE

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Keywords: ***cultural heritage; cementitious materials; green nanotechnology; antimicrobial properties; photocatalysis.***

The conservation of immovable cultural heritage requires construction materials that ensure structural compatibility and durability while limiting biological deterioration and environmental degradation. The ConstructHer project (77PED/2025) addresses these challenges through a transdisciplinary approach combining materials science, green chemistry, microbiology, and conservation engineering. The proposed strategy involves incorporating plant-derived compounds and green-synthesized metallic nanoparticles into cementitious and plaster-based formulations. Natural extracts, particularly those obtained from plants belonging to the Lamiaceae family, are investigated as bioactive components and as precursors for nanoparticle synthesis. The resulting materials are characterized in terms of physicochemical properties, antimicrobial and photocatalytic functionality, and compatibility with construction substrates. Particular attention is devoted to nanoparticle dispersion, formulation optimization, and the preservation of relevant mechanical properties.

Research activities have focused on developing multifunctional mortars and related construction materials incorporating natural compounds and nanostructured components. The integrated approach addresses the relationship between antimicrobial performance, photocatalytic activity, and the physicomechanical characteristics required for practical use. The workshop highlighted the necessity of optimizing the composition and distribution of functional additives while evaluating material compatibility, durability, and the potential impact of treatments on heritage substrates.

ConstructHer proposes a shift from conventional construction materials towards multifunctional formulations integrating protection against biodeterioration with improved environmental compatibility. The project establishes a research framework for developing sustainable materials applicable to cultural heritage conservation and specialized civil construction.

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ADVANCED ECOLOGICAL SOLUTIONS TO INCREASE THE FOOD SAFETY OF VEGETABLES AND FRUITS, FROM PRODUCER TO CONSUMER

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Keywords: ***food safety; fresh produce; natural surfactants; green formulations; decontamination.***

Fresh fruits and vegetables may carry pesticide residues, microorganisms, and other surface contaminants that compromise food safety. The development of environmentally friendly washing technologies is therefore important for reducing contamination while preserving the nutritional and sensory quality of fresh produce. The SIGUR project (57PTE/2025) addresses this challenge through the development and technological transfer of an innovative, bio-based washing solution. The proposed technology combines naturally derived surfactants with plant-derived bioactive compounds exhibiting antimicrobial potential. The research includes the development of environmentally responsible formulation components, optimization of extraction and processing approaches, and investigation of their suitability for fresh produce decontamination. Evaluation activities address contaminant removal, microbial load reduction, and preservation of relevant product-quality characteristics. Technological optimization also considers production feasibility and industrial implementation requirements.

The project has established an integrated technological approach combining natural surfactants and bioactive plant compounds for the removal of surface contaminants from fruits and vegetables. Research and development activities address formulation optimization, compatibility with different horticultural products, and the technological requirements for transferring the proposed solution towards industrial application. The workshop highlighted the importance of balancing decontamination performance with product safety, quality preservation, and process feasibility.

SIGUR promotes a sustainable approach to improving fresh produce safety by integrating green chemistry, natural bioactive compounds, and applied biotechnology. The proposed technology has the potential to support safer and more environmentally responsible postharvest practices while strengthening the connection between laboratory research and industrial applications.

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EXCELLENCE RESEARCH CENTER FOSTERING CLIMATE NEUTRALITY AND RESILIENCE THROUGH AGRICULTURE – AGROCLIN

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Keywords: ***climate-neutral agriculture; agricultural resilience; circular bioeconomy; sustainable technologies; research excellence.***

Achieving climate neutrality in agriculture requires integrated solutions addressing greenhouse gas emissions, resource efficiency, soil quality, biodiversity, and the resilience of agricultural systems. The AgroCliN Centre of Excellence (13CoEx/2026) was established to strengthen interdisciplinary research and innovation capabilities supporting the transition towards sustainable and climate-resilient agriculture. AgroCliN brings together six Romanian universities and research institutes, integrating expertise in agronomy, environmental sciences, biotechnology, chemistry, materials science, and Earth observation. Its research framework includes strategies for reducing greenhouse gas emissions, improving soil and ecosystem biodiversity, developing sustainable livestock practices, and valorizing natural and agricultural resources. Multiscale remote sensing, experimental platforms, and regional demonstration approaches complement the development of innovative materials, bio-based products, and environmentally responsible technologies. Consortium coordination is supported by integrated research planning, shared objectives, and collaborative activities across work packages.

The Centre has established a multidisciplinary framework connecting fundamental research, technological development, agricultural applications, and stakeholder engagement. A central component is Work Package 3, coordinated by ICECHIM, which focuses on the sustainable valorization of natural and agricultural resources for climate neutrality. Its activities connect green chemistry, advanced materials, resource recovery, and circular bioeconomy approaches with the broader agricultural objectives of the Centre. The consortium meeting organized within PRIOCHEM XXII provided a framework for reviewing research progress, identifying complementarities between work packages, and coordinating future interdisciplinary activities.

AgroCliN represents a strategic approach to advancing climate-neutral agriculture through scientific excellence, integrated research, and cooperation between complementary institutions. By combining advanced research with technological innovation, demonstration, and knowledge transfer, the Centre aims to accelerate the development and practical adoption of sustainable agricultural solutions.

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DEVELOPMENT OF ECO-FRIENDLY SILANE- AND NANOPARTICLE-BASED SOLUTIONS FOR THE CONSOLIDATION OF BUILDINGS AND MONUMENTS

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Keywords: ***cultural heritage; silanes; nanomaterials; structural consolidation; sustainable conservation.***

The deterioration of buildings and monuments due to environmental exposure, biological colonization, and mechanical degradation requires conservation technologies that combine material compatibility, long-term durability, and environmental responsibility. The NanoConsol project (47PTE/2025) aims to develop and transfer eco-friendly consolidation solutions based on silanes and functional nanoparticles, particularly for applications involving immovable cultural heritage. The technological approach involves hybrid formulations incorporating silane-based components and functional nanomaterials, designed to improve the characteristics of construction substrates. The research addresses formulation development, physicochemical characterization, antimicrobial functionality, and consolidation performance. Material–substrate compatibility, mechanical behavior, environmental resistance, and durability are considered essential evaluation criteria. The technological framework also includes the integration of monitoring approaches to assess treatment performance and support decisions concerning practical interventions.

The NanoConsol project establishes an integrated technological concept combining consolidation, functional protection, and monitoring. Its research activities address the development of hybrid materials intended to improve substrate cohesion and resistance to deterioration while incorporating additional protective properties. Particular attention is given to the compatibility of silane–nanoparticle systems with construction materials, their potential antimicrobial effects, and the requirements for technological validation and application on relevant substrates. The workshop highlighted the challenges associated with durability, implementation conditions, and technology transfer towards practical conservation applications.

The integration of silane chemistry, functional nanomaterials, and monitoring strategies offers a promising direction for developing sustainable consolidation technologies. NanoConsol aims to facilitate the transfer of innovative materials towards practical applications in construction and heritage conservation, contributing to more durable and environmentally responsible interventions.

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TECHNOLOGY READINESS LEVELS (TRLS): ARE THEY ENOUGH TO GUIDE INNOVATION TO SUCCESSFUL IMPLEMENTATION?

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Keywords: ***Technology Readiness Levels; technological maturity; innovation management; technology transfer; industrial implementation; readiness assessment..***

TRLs are widely used to assess technological maturity and support decision-making throughout research, development, and innovation processes. Originally developed for aerospace applications, the nine-level TRL scale has been adopted across numerous fields, including industrial research, energy, information technology, agriculture, and chemistry. However, its broader application raises important questions regarding the interpretation, consistency, and practical relevance of individual readiness levels, particularly when moving from experimental validation to industrial implementation and from one domain / field to another.

This roundtable aims to critically examine the capabilities and limitations of TRLs as instruments for guiding innovation towards successful implementation. Attention will be given to the potential ambiguities arising when aerospace-oriented definitions are transferred to civilian and industrial contexts, where technological performance represents only one of several conditions for success, to explore good practices for applying TRLs across different technological domains, identifying common interpretation pitfalls and opportunities for integrating TRL assessment with complementary approaches.

FUNDING OPPORTUNITIES FOR HARNESSING THE POTENTIAL OF DIATOMACEOUS EARTH TO REDUCE THE CARBON FOOTPRINT

Organized as a satellite event of the 22nd International Symposium *Priorities of Chemistry for a Sustainable Development – PRIOCHEM XXII*, the workshop brought together research organizations, businesses, public authorities and civil-society stakeholders to explore financing and partnership opportunities for the sustainable valorization of the Sibiciu de Sus–Pătârlagele diatomite deposit. The discussions positioned this Romanian mineral resource as a platform for climate-smart agriculture, rural development and new low-carbon value chains.

Diatomaceous earth consists predominantly of amorphous silica organised in a complex hierarchical network of mesopores and nanopores. Activation of the Pătârlagele material increased its specific surface area by 55.34% and its cation-exchange capacity by 53.14%, strengthening its potential as a carrier of nutrients, water and bioactive compounds.

The workshop evaluated two complementary carbon-farming solutions for the exploitation of the complex porous structure of diatomaceous earth.

1. Foliar application for climate-resilient carbon fixation. Activated diatomite forms a functional particle film on leaves and fruits. During hot, high-radiation periods, this film reduces leaf temperature and excessive evapotranspiration, protects the photosynthetic apparatus and supports C3/RuBisCO-mediated carbon fixation. The approach is particularly relevant to orchards and vineyards, where it can improve water-use efficiency, limit sunburn damage and preserve yield and product quality under summer heat stress. Field validation in the DiaSan Living Labs demonstrated significant agronomic responses in tomatoes, non-irrigated apple orchards and vineyards, including enhanced crop performance and increased polyphenol accumulation under selected treatments.

2. Granular soil application for enhanced carbon storage. Fine diatomite fractions can be converted into granules and applied as soil improvers. Their porous structure can enhance soil water retention and nutrient management, support root development and biological activity, and create favorable conditions for building and stabilizing soil organic carbon. Published research confirms that diatomite-based amendments can improve soil water-retention properties, particularly when combined with complementary materials such as biochar or bentonite. This route also enables the productive use of fine processing fractions, supporting a **zero-waste, circular valorization model**.

Strategic funding perspective. These two pathways form an integrated carbon-farming concept: foliar treatments sustain the biological capture of atmospheric CO_2 by crops, while granular soil amendments support its longer-term retention in soil. The concept is aligned with Regulation (EU) 2024/3012, which established the first EU-wide voluntary certification framework for permanent carbon removals, carbon farming and carbon storage in products, supported by quality criteria, monitoring, reporting and third-party verification.

The workshop therefore identified a clear direction for future investment: multidisciplinary projects combining material activation and granulation, orchard and vineyard demonstrations, soil-carbon monitoring, life-cycle assessment, digital measurement–reporting–verification tools, and techno-economic validation. By connecting research, mineral-resource operators, farmers, technology providers, investors and public authorities, Romania diatomite resource can become the foundation of scalable agricultural inputs that simultaneously strengthen climate resilience, soil health, rural competitiveness and verifiable carbon-farming outcomes.

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The foundations of the group date back to 1992, when Laboratoarele Medica began its activities in research and manufacturing. Today, the group's integrated structure brings together **Laboratoarele Medica**, responsible for research, formulation, and production; **Pro Natura**, focusing on brand development and commercialization; and **Medica Farmimpex**, supporting distribution and partnerships.

Research, Biotechnology and Product Innovation

Scientific research and technological innovation represent essential components of Pro Natura's development strategy. Under the scientific vision of **Dr. Ionuț Moraru**, physician, researcher, and inventor, the Medica Group has developed original formulations and participated in national and European research projects, including the Eureka 3Biotics Plus initiative.

A distinctive technological direction is the use of **controlled fermentation processes** to transform natural substrates into innovative ingredients and functional formulations. The proprietary **3xBiotics® platform** illustrates this approach through products such as:

- **AMRITA®** – polyfloral pollen fermented using symbiotic SCOBY cultures;
- **COL-KEFIR®** – bovine colostrum fermented with kefir grains;
- **Apilarnil 3xBiotics** – formulations combining bee-derived ingredients and fermented substrates.

These technologies reflect the company's commitment to integrating natural bioactive ingredients, fermentation biotechnology, and scientific knowledge into the development of differentiated products.

A Diversified Portfolio of Natural Products

Pro Natura offers a broad portfolio of products covering several complementary areas:

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Natural Cosmetics and Personal Care: Creams, gels, serums, shampoos, and topical formulations incorporating selected natural ingredients.

Fermented Products and Functional Foods: Kombucha-derived products, balsamic vinegars, fermented ingredients, gummies, and other innovative formulations.

The development process benefits from the research, analytical testing, formulation, manufacturing, and quality-control capabilities of Laboratoarele Medica, supporting an integrated approach from initial concept to finished product.

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Through its research-oriented philosophy, Pro Natura promotes the transformation of scientific knowledge into practical products, encouraging cooperation between researchers, technology developers, and industrial partners.

Metrohm Analytics Romania SRL

Metrohm is a worldwide leading manufacturer of precision instruments for chemical analysis. In the field of electrochemical ion analysis, we have been the world number one unchallenged for many years. But we offer much more than just instruments. In our laboratories we develop tailor-made applications that help our customers to safeguard the quality of their products, to comply with regulations and to optimize processes.

Well-known companies from all industrial sectors prefer our instruments and can rely worldwide on local after-sales service and support. Our customers come from the chemical, petrochemical and pharmaceutical industries, as well as from the automotive and food sectors. The metal and electronics industries, water and environmental analysis and research and training are further fields in which our analytical instruments provide highly accurate results.

The history of our company starts in 1943. That was when the engineer Bertold Sühner started constructing technical apparatus in Herisau, Switzerland. Bertold Sühner was a brilliant inventor. Among other things he constructed radios, oscilloscopes and teraohmmeters, i.e. instruments with which extremely high electrical resistances can be measured. Bertold Sühner 's philosophy still guides us today. Independence plays the central role in this philosophy. We have always grown from our own strength and have never surrendered our independence to banks or the stock market. This gives us the freedom to make long-term plans and decisions – in the interest of our customers, our employees and our region.

Since our foundation more than 70 years ago, we have been manufacturing exclusively at our headquarters in Herisau. In times in which whole industries are shifting production to supposedly cheaper locations abroad, we are still producing here with a unique manufacturing depth: We turn and mill all the components for our instruments ourselves. We manufacture our own print ed circuit boards for the control electronics, the columns for our ion chromatographs, and the glass membranes for our electrodes. We even have our own state-of-the-art printing facility where the technical documentation for our instruments is printed. Of course, the entire assembly operation is also located in Herisau.

In a competition driven solely by price, quality will inevitably suffer. Therefore, we don't even get involved in this type of competition. However, our products and services are the first choice for all those who demand uncompromising quality at a reasonable price. It starts with the fact that we have not outsourced our production but keep it at our headquarters in Herisau. On top of this comes our manufacturing depth. Our customers can rely on the fact that virtually 100 percent of the components of a Metrohm instrument have been developed and manufactured in Herisau. Ultimately, it is our employees who make the crucial difference. Responsibility for quality is not delegated at Metrohm but is regarded as personal responsibility of each individual throughout each production step. This culture of care and self-responsibility pays for itself. An ever-increasing number of customers rely on Swiss quality from Herisau and many have been loyal to our brand for decades.

We do not just attempt to be as independent as possible in the development and production of our instruments – we also keep sales and distribution in our own hands. Metrohm is exclusively represented in more than 80 countries, of which more than 40 we have our own subsidiaries. This guarantees a close network for sales and service. A total of 1900 employees are working for us outside Switzerland and achieve more than 90 percent of our turnover there.

"When in Rome, do as the Romans do". Good advice, particularly in sales. We follow the consequences of this proverb with our own logic – and use local employees in our subsidiaries right from the start. They know their markets and are perfectly familiar with the culture of their country.

We don't follow the trends – we make them!



NanoTeam *is a Romanian company specialized in providing advanced laboratory instruments for research, development, and industrial applications, as well as for biodiversity, environmental studies, universities, and scientific centers.*

Its website highlights a diverse portfolio that includes:

- *Hitachi electron microscopes (SEM, TEM) and sample preparation systems,*
- *confocal Raman spectroscopy,*
- *atomic force microscopes (AFM),*
- *thermal analysis systems (DSC, STA/TGA, TMA, DMA),*
- *high-resolution IR spectroscopy (e.g., Molecular Vista),*
- *XPS, Auger, and ToF-SIMS systems,*
- *multi-nuclear NMR spectroscopy (Oxford Instruments),*
- *flow chemistry systems (Vapourtec), and others.*

The company presents itself as a reliable technical partner with strong technical and scientific expertise, offering solutions tailored to customer needs, post-sale support, and consultancy for equipment integration.

Based in ***Cluj-Napoca, Romania****, NanoTeam places emphasis on innovation, performance, and quality in delivering high-level scientific instruments.*

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- **Young and enthusiastic team, we've started to operate in 2024**
- **The company was founded by a team with over 14 years of extensive experience in research and industrial sales, significantly contributing to the design, implementation, and commercialization of a wide range of innovative products.**
- **Phanos Technology SRL is ISO 9001 and ISO 14001 certified, demonstrating the company's commitment to consistently meeting customer requirements and exceeding their expectations while adhering to high standards of quality and environmental management.**
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- **CEO – Nicu Becherescu, PhD in Physics, with a specialization in Condensed Matter Physics and Quantum Mechanics**
- **COO- Surupaceanu Ionut, MS Physics, with a specialization in Laser Physics.**

Company profile



Marketing & Business Development: The company began its activity by providing specialized marketing services for companies in the technical field, playing a crucial role in online promotion, developing growth strategies, and managing investor relations. Additionally, the company actively participated in the design and implementation of research and development projects, further establishing its reputation as a trusted partner for its clients.



Sales: In the next stage of its development, the company leveraged its accumulated experience towards the commercialization of scientific and industrial equipment, supplied by external partners. By continuing to support our partners, we have developed a complementary portfolio of products and services, allowing us to offer additional solutions to the same customer profile. Thus, we were able to better meet their needs and consolidate our position in the market.



Research projects: We are actively involved in research projects where we assist research centers in advancing and maturing their developed technologies. These projects are supported by both national and European funding, enabling us to innovate and deliver competitive products

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TOPO MINIERA S.R.L. is a privately owned Romanian company established in 2009, specializing in geospatial engineering, topographic and hydrographic surveys, geological investigations, environmental assessments, and technical services for infrastructure and renewable energy projects.

Based in Constanța, Romania, the company brings together a multidisciplinary team of 36 professionals, including geodetic engineers, geologists, mining engineers, environmental specialists, biologists, and technical experts. Combining extensive field experience with advanced measurement technologies, TOPO MINIERA delivers integrated solutions for complex engineering, environmental, and territorial development projects.

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- Geological and Mining Engineering: Geological investigations, mineral resource assessments, technical documentation, quarry planning, and engineering support for mining activities.
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A distinctive strength of TOPO MINIERA is its investment in advanced technologies for high-precision data acquisition and spatial analysis. The company's technical infrastructure includes professional terrestrial and mobile LiDAR systems, GNSS/RTK positioning equipment, unmanned aerial vehicles, multibeam bathymetric systems, underwater inspection equipment, and Ground Penetrating Radar (GPR). These technologies enable accurate three-dimensional documentation, infrastructure monitoring, non-invasive investigations, and digital reconstruction of complex natural and built environments. Their applications extend to cultural heritage documentation, coastal management, environmental investigations, engineering design, and the assessment of existing infrastructure.

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TOPO MINIERA has contributed to numerous projects throughout Romania, including bathymetric investigations along the Black Sea coast, hydrographic studies for navigation safety, extensive LiDAR surveys for infrastructure corridors, and technical documentation for renewable energy developments. The company has also undertaken three-dimensional documentation and digital modelling of historical buildings, demonstrating the potential of advanced geospatial technologies in cultural heritage assessment and conservation.

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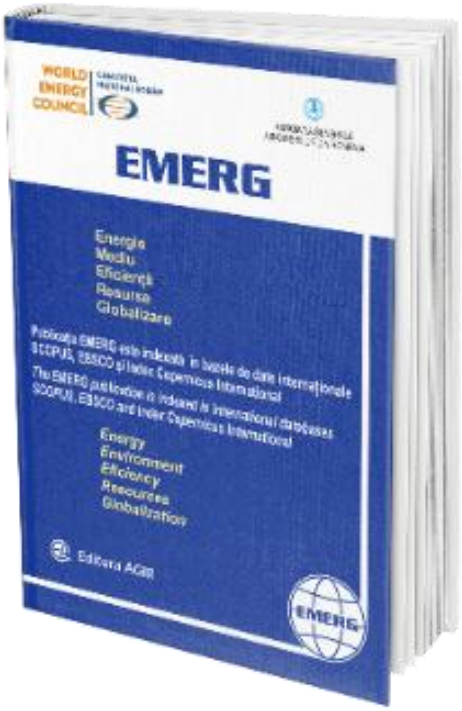
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