20th International Scientific Conference

THE VITAL NATURE SIGN

May 14th-15th, 2026

Kaunas, Lithuania

ABSTRACT BOOK

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Editors:

Prof. Habil. Dr. Audrius Maruška, Dr. Nicola Tiso, Dr. Vilma Kaškonienė, Dr. Mantas Stankevičius.

Disclaimer:

The organizers are not responsible for the contents of the abstracts published in this book.

Personal data of the participants is not collected and will not be stored or transferred to third party. Providing personal data is voluntary, but necessary for the administration of the conference.

Overview of the International Interdisciplinary Scientific Conference

The Vital Nature Sign 2026

The international interdisciplinary scientific conference Vital Nature Sign – 2026 brought together an impressive number of participants and presentations. In total, 100 presentations were delivered, including 44 oral presentations and 56 flash presentations. The geographical diversity of presenters was particularly broad, with participants representing institutions from Italy, Poland, Syria, Germany, Ukraine, Nigeria, Algeria, the United Kingdom, the United States, Sweden, Belgium, Serbia, North Macedonia, India, Nepal, and, of course, Lithuania. Overall, more than 16 countries were represented at the conference. The multidisciplinary sections showcased the latest research results in both specialized and interdisciplinary scientific fields.

The conference was opened by its initiators, Dr. Reda Dzingelevičienė and Dr. Vykintas Baublys. They presented an overview of the conference's early years, when it began as a student scientific conference initially organized by the leading student scientific organization of the Faculty of Natural Sciences.

Later, the Vice-Rector for Science of Vytautas Magnus University, Dr. Rolandas Urbonas, delivered the opening address. He emphasized the importance of scientific conferences within the modern scientific system and highlighted the significance of maintaining academic traditions in conference organization. He welcomed all participants and wished them fruitful discussions and successful future collaborations and projects.

The Dean of the Faculty of Natural Sciences, Assoc. Prof. Dr. Jūratė Žaltauskaitė, also greeted both the audience gathered in person and those attending remotely. She wished all participants creative success during the conference.

Subsequently, the conference chair, Prof. Audrius Maruška, addressed the participants. He discussed several important aspects of the conference, including its interdisciplinary and multidirectional nature, international character, the participation of several generations of scientists, and the importance of knowledge transfer from experienced researchers to young scientists. He also stressed the significance of scientific conferences within the study process.

Prof. Maruška thanked the conference organizers for their continuous and dedicated work and reflected on whether twenty years constitutes a long period in the development of a scientific conference. Undoubtedly, during this time the conference has evolved into a mature international interdisciplinary scientific event, widely attended not only by doctoral and master's students, but also by international scientific experts. He emphasized that the conference serves as an important educational platform where many researchers have delivered their first scientific presentations - memories they retain throughout their lives.

Particular attention was paid to the conference's evolution: from a student conference to a young researchers' conference, and eventually into a solid international interdisciplinary scientific conference. The speaker noted that this was likely the first conference in Lithuania to declare interdisciplinarity as a central objective from its very beginning.

Prof. Maruška expressed gratitude to the organizers, without whose dedication and consistent work the event would not have been possible. He also mentioned the conference patron, former Rector of Vytautas Magnus University, Prof. Juozas Augutis.

The organization of the conference was strongly supported by the staff, doctoral students, and students of the Open Access Center for Instrumental Analysis of the Faculty of Natural Sciences at VMU, the Biophysics Research Group, researchers from Lithuanian and foreign institutions, as well as the Faculty Dean's Office, which assisted with organizational matters. Financial and organizational support was provided by Vytautas Magnus University, the Lithuanian Academy of Sciences, and the Nordic Separation Science Society. The conference was also actively supported by long-term social partners, including *Analytical Solutions*, *Biotecha*, *Armgate*, *Merck*, and others.

The conference began with invited lectures under the session entitled Biotechnology, Bioremediation, Biochemistry, and Bioanalysis; Natural Products; Separation Science: Development & Applications.

The first lecture, dedicated to green chromatography and innovations in this field, was delivered by Dr. Egidijus Machtejevas from Merck, Darmstadt, Germany. He reviewed ecological and economic aspects

related to sustainable separation strategies, which remain among the principal molecular analysis methods for investigating complex natural, environmental, and synthetic mixtures.

Later, Professor Massimo Zacchini from Italy presented research on the risks posed by water-soluble polymers to living organisms. Dr. Enrica Donati from the National Research Council of Italy delivered a presentation entitled “Impact of Selenium Biofortification on the Glucosinolate Profile and Secondary Metabolism of Savoy and Tuscan Cabbage.”

Prof. Ákos Végvári from the Karolinska Institute, Sweden, explored the subtleties of single-cell analysis in his presentation “Single Cell Proteomics – Quo Vadis?” Algimanta Kundrotaitė from the Lithuanian Research Centre for Agriculture and Forestry discussed the risks associated with heavy metals during biochar production from various bio-waste materials. Together with colleagues, she investigated how these risks depend on pyrolysis temperature.

The conference also addressed topics related to lipid metabolism, cancer prevention, skin protection against oxidative stress, the application of electroporation in anticancer research, and the development of microplastic detection methods. All presentations stimulated active discussions and audience questions. Due to the large number of presentations, several parallel sessions were organized.

A special session chaired by Assoc. Prof. Dr. Jūratė Žaltauskaitė was dedicated to the topic “Climate Change and Sustainable Construction.”

Later interdisciplinary sessions covered topics such as the comparison of fatty acid composition in animal fats, the investigation of anthocyanin extracts, valorization of sugar beet pulp using fungal fermentation, the antimicrobial potential of bacteria isolated from honey against antibiotic-resistant pathogens, development of methods for detecting toxic alkaloids, chemical profiling of strawberry berries, and the analysis of “super berries” using liquid chromatography–UV methods.

The flash presentations covered a particularly wide spectrum of topics, ranging from electrochemical sensor development and organic synthesis to the application and characterization of bioproducts.

On the following day, significant interest was generated by Dr. Tomas Drevinskas from the NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA. His presentation, “From Chemical Signatures to Life Detection: Analytical Instrumentation for Exploration,” focused on analytical technologies for detecting life in the water-bearing moons of planets and catalyzed an active discussion.

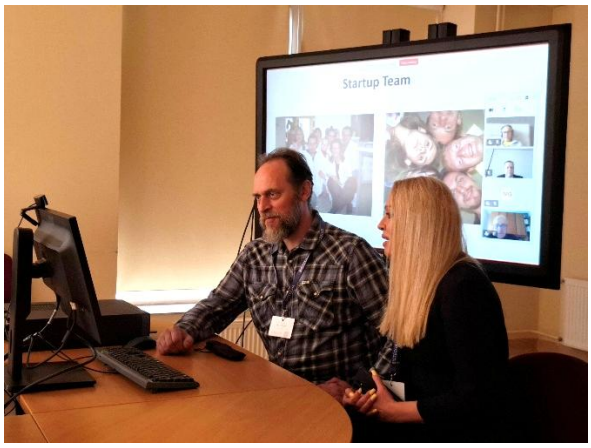
Additional presentations addressed topics such as controlled embryo environments, “Novel Lead for Male Contraceptives – Total Synthesis of Rhynchone A,” microplastics in soil, the influence of controlled environments on the growth of medicinal and aromatic plants, drought response depending on ploidy level, and short-term changes in plasma lipidome composition following myocardial infarction.

Several presentations focused on nanomaterial toxicity, energy-related research, environmental sciences, biomedicine, food and biomass technologies. Another group of presentations explored the application of information technologies and artificial intelligence across various fields of science and technology.

During the concluding discussion, it was decided to reconsider the timing of next year’s VNS conference, taking into account the large number of scientific conferences organized in May and the resulting overlap of dates, which complicates researchers’ ability to participate in desired events. In the final discussion, Professor Massimo Zacchini emphasized the conference’s evolution and progress in terms of thematic scope and presentation quality. The conference concluded with wishes for the successful implementation of new ideas and future scientific achievements.

Prof. Habil. Dr. Audrius Maruška (Conference Chair), Dr. Mantas Stankevičius, Dr. Vilma Kaškonienė (Organizing Committee)

Moments of the Conference



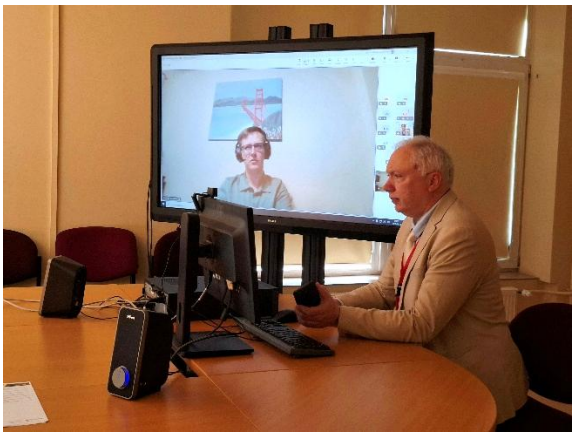
Opening remarks by the conference founding organizers Dr. Reda Dzingelevičienė (Klaipėda University) and Dr. Vykintas Baublys (Vytautas Magnus University).

The generation of young scientists who grew up with the VNS conference – Dr. Reda Dzingelevičienė (Klaipėda University), Dr. Olga Kornyšova (UAB Biotecha), Dr. Rasa Žūkienė (Vytautas Magnus University), Dr. Vilma Ratautaitė (State Research Institute Center for Physical Sciences and Technology) and Dr. Egidijus Machtejevas (MERCK, Darmstadt, Germany).

Waiting for the participants of the morning session of the VNS conference.

Discussion during the break of the jubilee hybrid VNS conference – Prof. Andrei Malkov (Loughborough University, UK), Academician Audrius Maruška (Vytautas Magnus University) and Dr. Yanal Alkuddsi (Al-Sham Private University, Syria).

Awarding of a certificate of appreciation for long-term contribution to the organization of the conference to Dr. Rūta Mickienė (Vytautas Magnus University).



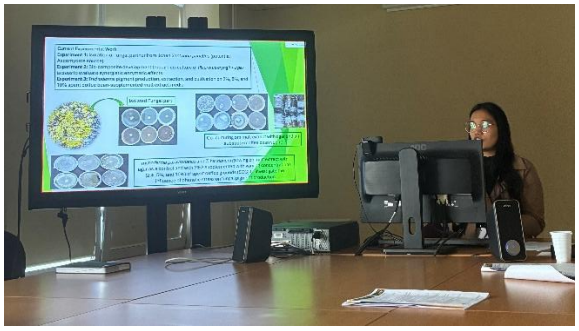
Dr. Tomas Drevinskas (NASA Jet Propulsion Laboratory, California Institute of Technology, United States) participating online in a discussion with the conference chair on site.

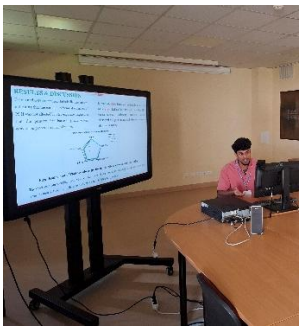


Presentation of certificates of appreciation to Dr. Benas Gabrielis Urbonavičius (Kaunas University of Technology), Dr. Karolina Barčauskaitė (Lithuanian Research Centre for Agriculture and Forestry), and Prof. Andrei Malkov in recognition of their long-term contribution to conference participation and collaboration.

Academician Audrius Maruška and Prof. Andrei Malkov.

Group of participants at the end of the conference.



Presentations by early-career researchers and young conference participants.

20th International Scientific Conference "The Vital Nature Sign" Program

Thursday, 14th of May 2026

Hybrid conference (in-person + online participation):

Venue: Vytautas Magnus University, Faculty of Natural Sciences, Universiteto St. 10, Room 154, Akademija, Kaunas District, Lithuania or **Microsoft Teams** *Link 1: HYBRID participation*

Online-only sessions

Microsoft Teams *Link 2: ONLINE sessions*

9.00-9.30 (Time zone GMT+3) **Opening of the conference:**
Founding Organizers Prof. Dr. Reda Dzingelevičienė and Assoc. Prof. Dr. Vykintas Baublys
Vice-Rector for Research and Innovations Dr. Rolandas Urbonas (Vytautas Magnus university)
Dean of the Faculty of Natural Sciences Assoc. Prof. Dr. Jūratė Žaltauskaitė
Chairman of the conference Prof. Habil. Dr. Audrius Maruška

Oral presentations (hybrid) *Link 1: HYBRID participation*

Session on Biotechnology, Bioremediation, Biochemistry, and Bioanalysis; Natural Products; Separation science: Development & Applications

Chairpersons: Prof. Dr. Ákos Végvári; Prof. Habil. Dr. Audrius Maruška

9.30-9.45	*Invited Speaker* **Advancing Sustainable Liquid Chromatography: Green Solvents, Method Optimization, and CoreShell Innovations** Egidijus Machtejevas *Life Science, Chemistry, Analytical Chemistry, Merck Life Science KGaA, Darmstadt, Germany*
9.45-10.00	*Invited Speaker* **Water-Soluble Synthetic Polymers (WSSPs) as Emerging Concern for the Aquatic Environment: a Preliminary Study on the Effects of Polyvinylpyrrolidone (PVP) on Animal and Plant Bioindicators** Massimo Zacchini, Valentina Iannilli, Samuele Terranegra, Francesca Lecce, Laura Passatore, Serena Carloni, Anna Wyrwicka-Drewniak, Grazyna Chwatko, Fabrizio Pietrini *National Research Council of Italy*
10.00-10.15	*Invited Speaker* **Impact of Selenium Biofortification on the Glucosinolate Profile and Secondary Metabolism of Savoy and Tuscan Cabbage** Enrica Donati, Zeineb Aturki, Giovanni D'Orazio, Lázaro-Armando Pérez-Acosta, Mercè Llugany, María-Jesús Sánchez-Martín, Danilo Corradini *National Research Council of Italy*
10.15-10.30	*Invited Speaker* **Single Cell Proteomics – Quo Vadis?** Ákos Végvári *Karolinska Institute, Sweden*
10.30-10.45	**Assessment of Heavy Metal–Related Ecological Risks of Biochar Produced from Various Biowastes at Different Pyrolysis Temperatures** Algimanta Kundrotaitė, Karolina Barčauskaitė *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*

10.45-11.00 ***Coffee break***

11.00 (time zone GMT+3) Oral presentations

Parallel session (hybrid): ***Session on Biotechnology, Bioremediation, Biochemistry, and Bioanalysis; Natural Products; Separation Science: Development & Applications*** *Link 1: HYBRID participation*		***Parallel session (only online):*** ***Special Session on Climate Change and Sustainable Construction organized by the EUKI project EU-REPAIR*** *Link 2: ONLINE sessions*	
Chairpersons: Dr. Vilma Ratautaitė; Assoc. Prof. Dr. Benas G. Urbonavičius		***Chairperson: Assoc. Prof. Dr. Jūratė Žaltauskaitė***	
11.00-11.15	**Regulatory Role of Phytocannabinoids in Relation to Melanocyte Lipid Metabolism** Michał Biernacki, Iwona Jarocka-Karpowicz, Audrius Maruska, Elżbieta Skrzydlewska *Medical University of Białystok, Białystok, Poland*	**11.00-11.15**	**Energy Efficiency and Heritage Preservation on Serbia's Valuable Built Environment** Marko Mančić, Milena Rajić, Miomir Vasov *University of Nis, Serbia*
11.15-11.30	**Skin Cancer Prevention and Treatment with Natural Compounds: Is It Real?** Sinemyiz Atalay Ekiner, Agnieszka Gęgotek, Elżbieta Skrzydlewska *Medical University of Bialystok, Bialystok, Poland*	**11.15-11.30**	**Frameworks and Challenges: Insights from the EU-REPAIR Estonian National Study** Triinu Väikmeri, Triin Reidla *Estonian Academy of Arts*
11.30-11.45	**Combined Effects of Cannabigerol and 3-O-ethyl Ascorbic Acid on Oxidative Stress In UVB-irradiated Keratinocytes** Iwona Jarocka-Karpowicz, Aleksandra Kacprowska, Audrius Maruska, Elżbieta Skrzydlewska *Medical University of Bialystok, Bialystok, Poland*	**11.30-11.45**	**Sustainable repair and refurbishment in VBE in North Macedonia (EU-REPAIR project)** Suzana Kasovska Georgieva, Slavica Trajkovska, Pande Pop Antoska *IECE*
11.45-12.00	**Effect of Marine Microalgae Lipid Extract on Skin Cells in in vitro Model of Healthy Cells, As Well As Psoriatic and Melanoma Cells. A Proteomic Insight** Agnieszka Gęgotek, Michał Biernacki, Adam Wroński, Pedro Domingues, Maria Rosário Domingues, Elżbieta Skrzydlewska *Medical University of Bialystok, Bialystok, Poland*	**11.45-12.00**	**Sustainable Refurbishment of Valuable Built Environment in Germany: Gaps, Barriers, and Lessons for Practice** Milica Mügge *Fraunhofer-Institut für Bauphysik IBP, Germany*
12.00-12.15	**Calcium-Driven Enhancement of Calcein Release in Electroporated Wild Type and ANXA4 Knockout MCF7 Cells** Subitha Mathiazhagan, Baltramiejus Jakštys, Saulius Šatkauskas Vytautas Magnus university Kaunas, Lithuania	**12.00-12.15**	**Stakeholder Insights on Sustainable Refurbishment of Valuable Built Environment in Lithuania** Gintarė Sujetovienė, Renata Dagiliūtė, Jūratė Žaltauskaitė *Vytautas Magnus University*
12.15-12.30	**Rethinking Nile Red: Can Sustainable Fluorescent Dyes Enable Greener Microplastic Detection?** Dovilė Motiejauskaitė, Karolina Barčauskaitė *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*		

12.30- 13.30 Lunch break

13.30 (time zone GMT+3) ***Oral Presentations (hybrid)*** *Link 1: HYBRID participation*

Session on Biotechnology, Bioremediation, Biochemistry, and Bioanalysis; Natural Products; Separation Science: Development & Applications

Chairpersons: prof. dr. Arvydas Kanopka; dr. Egidijus Machtejevas

13.30-13.45	**Comparison of Fatty Acid Composition in Animal-Derived Fats, Assess their Compliance with Dietary Recommendations** Mikas Kristupas Juodelis *Lithuanian University of Health Sciences, Kaunas, Lithuania*
13.45-14.00	**Changes in Extractable Anthocyanin Content Stability in Anthocyanin-Rich Winter Wheat (*Triticum aestivum* L.) Breeding Lines** Jurinta Voišvilo, Žilvinas Liatukas, Jurgita Cesevičienė *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*
14.00-14.15	**Valorization of Sugar Beet Pulp through Fungal Fermentation: Effects of Pretreatment on Protein and Nutritional Quality** Žydrūnė Gaižauskaitė, Daiva Žadeikė *Kaunas University of Technology, Kaunas, Lithuania*
14.15-14.30	*Not presented (abstract not included)* **Antimicrobial Potential of Honey-Derived Bacteria Against Clinically Relevant and Antibiotic-Resistant Pathogens: The Prominent Role of *Bacillus pumilus*** Dominika Błońska, Michał Szumski, Bogusław Buszewski *Nicolaus Copernicus University, Toruń, Poland*
14.30-14.45	**The Simplified Method for The Determination of Toxic Alkaloids from Various Parts of *Datura* L. by Use of Chromatographic and Spectroscopic Techniques** Magdalena Ligor, Monika Dworakowska, Tomasz Ligor *Nicolaus Copernicus University, Toruń, Poland*
14.45-15.00	**Phytochemical Profile of Strawberries: The Role of Phenols and Antioxidants in Determining Micromycete Prevalence Across Maturity Stages** Jūratė Staveckienė, Rūta Mickienė, Gabrielė Vasiliauskienė, Jurgita Kulaitienė *Vytautas Magnus University Agricultural Academy, Kaunas, Lithuania*
15.00-15.15	**Analysis of Berry Superfruits for Total Thiol Content by LC-UV-Based Method** Marta Gawel, Rafal Głowacki, Justyna Piechocka *University of Lodz, Lodz, Poland*

15.15-15.30 **Coffee break**

15.30 (time zone GMT+3) **Flash presentations I.**

	Parallel session (hybrid): ***Session on Biotechnology, Bioremediation, Biochemistry, and Bioanalysis; Natural Products; Separation Science: Development & Applications*** *Link 1: HYBRID participation*		***Parallel session (only online):*** ***Session on Biotechnology, Bioremediation, Biochemistry, and Bioanalysis; Natural Products; Separation Science: Development & Applications*** *Link 2: ONLINE sessions*
	Chairpersons: Dr. Mantas Stankevičius; MSc. Kristina Bimbiraitė-Survilienė		***Chairpersons: Prof. Dr. Giedrė Samuolienė; Assoc. Prof. Dr. Vilma Kaškonienė***
15.30	**Determination of The Antiradical Activity In Vitro of *Chaenomeles japonica* (Thunb.) Lindl. Ex Spach Fruit Extracts Using the Spectrophotometric TFPH Assay** Kornelija Kondrotaitė, Mindaugas Liaudanskas, Rima Šedbarė, Jonas Viškelis, Pranas Viškelis, Valdimaras Janulis *Lithuanian University of Health Sciences, Kaunas, Lithuania*	**15.30**	**Survival of Foodborne Gram-Positive Bacteria in Lactoferin Powder and Solution** Zuzanna M. Kołodziejska, Klaudia K. Idzik, Ewelina Sibińska, Oleksandra Pryshchepa, Paweł P. Pomostowski *Nicolaus Copernicus University, Toruń, Poland*
15.37	**Controlled Environment Agriculture for High-Value Pharmaceutical Crop in Vertical Farms** Justinas Raginskis, Akvilė Viršilė, Giedrė Samuolienė *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*	**15.37**	**Varietal Effects on The Quality and Rheological, Physical Properties of Oat Milk** Ernesta Trečiokienė, Jurgita Mikašauskaitė-Tiso, Ingrida Kraujutienė *Kauno kolegija Higher Education Institution*
15.44	**Bridging Molecular Targeting and Electrochemical Sensing with Polydopamine-Based Imprinted Sensors for Tetracycline Detection** Danish Khalid, Ernestas Brazys, Vilma Ratautaitė, Arūnas Ramanavičius *Vilnius University, Vilnius, Lithuania*	**15.44**	**Synthesis, Spectroscopic Characterization, and Biological Evaluation of a Lactoferrin-Oxaliplatin Complex for Targeted Oral Delivery** Paweł Fijałkowski, Oleksandra Pryshchepa, Justyna Walczak-Skierska, Paweł Pomastowski, Katarzyna Rafińska *Nicolaus Copernicus University, Toruń, Poland*
15.51	**Characterisation of Phytochemical Diversity in *Chrysanthemum morifolium* Residual Biomass** Ieva Karpavičienė, Akvilė Viršilė, Justinas Raginskis, Giedrė Samuolienė *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*	**15.51**	**The Influence of Phospholipid Profile and Fatty Acid Composition on the Physicochemical Parameters of Natural Emulsion Systems** Dominika Przybysz, Oleksandra Pryshchepa, Paweł Pomastowski *Nicolaus Copernicus University, Toruń, Poland*
15.58	**Influence of Different Processing Methods on Bee Pollen Phytochemical Composition** Gabija Stragauskytė, Mindaugas Liaudanskas, Neringa Sutkevičienė, Žvikas Vaidotas, Sonata Trumbeckaitė *Lithuanian University of Health Sciences, Kaunas, Lithuania*	**15.58**	**Formation and Characterization of Whey Protein-Anthocyanin Complexes Obtained from Black Elderberry Juice: Binding Kinetics, Structural Interactions, Antioxidant Potential and Thermal Stability** Magdalena Królikowska, Jarosław Głogowski, Wioletta Jaruga, Paweł Pomastowski, Katarzyna Rafińska *Nicolaus Copernicus University, Toruń, Poland*
16.05	**Deactivation and Magnetization of *Trichoderma harzianum* Spores for Applications in Drug Delivery** Monika Juselytė, Nicola Tiso	**16.05**	***Coriolus versicolor* Extracts Restore Macrophage Responsiveness by Reversing Endotoxin Tolerance in RAW264.7 Cells** Kacper Roszak, Tomasz Jędrzejewski, Sylwia Wrotek *Nicolaus Copernicus University, Toruń, Poland*
16.12	**The Research and Application of Medicinal (Aromatic) Plants to Solve Human Health Problems in Various Scientific Fields** Abdellah Benamar Belarbi, Ona Ragažinskienė *Vytautas Magnus University, Kaunas, Lithuania*	**16.12**	**Novel PH-Responsive Poly(2-Oxazoline) Lipid Nanocapsules with Imidazole for Enhanced Photodynamic Antitumor Activity** Solomiya Paryzhak, Tetiana Dumych, Oksana Kharchenko, Oksana Krupka *Danylo Halytsky Lviv National Medical University, Lviv, Ukraine*
	Parallel session (hybrid): ***Session on Biotechnology, Bioremediation, Biochemistry, and Bioanalysis; Natural Products; Separation Science: Development & Applications*** *Link 1: HYBRID participation*		***Parallel session (only online):*** ***Session on Biotechnology, Bioremediation, Biochemistry, and Bioanalysis; Natural Products; Separation Science: Development & Applications*** *Link 2: ONLINE sessions*

16.20	**Feeding Pressure-Dependent Transition in Critical Translation Speed for Melt Electrowriting of Tissue Engineering Scaffolds** Laura Kairytė, Karolis Gedvilas, Raminta Rodaitė, Arminas Girlevičius, Saulius Mickevičius, Darius Milčius *Vytautas Magnus University, Kaunas, Lithuania*	**16.20**	**Poly(2-Alkyl-2-Oxazoline)-Coated Gold Nanospheres as Novel Agents for Photothermal Antitumor Therapy** Tetiana Dumych, Solomiya Paryzhak, Lea Daoud, Oksana Krupka *Danylo Halytsky Lviv National Medical University, Lviv, Ukraine*
16.27	**Nisin Variants: Evaluating the Dual-Action Potential of Bacteriocins in Antimicrobial and Oncological Applications** Gabija Žiūraitė, Vilma Kaškonienė, Rūta Mickienė, Arūnas Kazlauskas *Vytautas Magnus University, Kaunas, Lithuania*	**16.27**	**Activity of Metal and Metal Oxide Nanoparticle-Enhanced Cotton Material Against Fungi of the *Malassezia pachydermatis*** Agnė Giedraitienė, Rita Šiugždinienė, Monika Šiugždinytė, Raminta Rodaitė, Darius Milčius *Lithuanian University of Health Sciences, Kaunas, Lithuania*
16.34	**Bioactive Pigment-Integrated Fungal Bio-Composites for Sustainable Material** Simran Dhull, Audrius Maruška, Adesh Kumar, Nicola Tiso, Rūta Mickienė, Kristina Bimbiraitė-Survilienė *Lovely Professional University, Punjab, India/ Vytautas Magnus university, Kaunas, Lithuania*	**16.34**	**Evaluation of Phenolic Compound Content and Antioxidant Activity of *Viburnum opulus* L. 'Leningradskaja Otbornaja' Leaves During Vegetation** Saida Palenčiūtė, Lina Raudonė, Laima Česonienė *Lithuanian University of Health Sciences, Kaunas, Lithuania*
16.41	**Potential of *Aegopodium podagraria* L. in Enhancing Antibiotic Efficacy Against Selected Bacterial Strains** Ugnė Gabrytė, Rūta Mickienė, Audrius Sigitas Maruška *Vytautas Magnus University, Kaunas, Lithuania*	**16.41**	**Effect of Gellan Gum Concentration on the Mechanical Properties of Edible Gels with Linden Honey and Chaga Powder** Ernesta Zaksaitė, Inga Matulytė, Mindaugas Liaudanskas, Sonata Trumbeckaitė *Lithuanian University of Health Science, Kaunas, Lithuania*
16.48	**Effect of Lactoferrin Powder and Solution on the Growth of Food-Associated Gram-negative Bacteria** Klaudia K. Idzik, Zuzanna M. Kołodziejska, Ewelina Sibińska, Oleksandra Pryshchepa, Paweł Pomostowski *Nicolaus Copernicus University, Toruń, Poland*	**16.48**	**Physiological and Biochemical Responses of *Betula pendula* to Heavy Metal Stress** Emilija Mukaitė, Dorotėja Vaitiekūnaitė, Greta Striganavičiūtė, Milana Šilanskienė, Vaida Sirgedaitė-Polikaitienė *Vilnius University, Lithuania*
16.55	**Supersaturated Complex of Bovine Lactoferrin – Does Its Therapeutic Potential Align with Its Safety Profile** Michał Maciejewski, Oleksandra Pryshchepa, Paweł Pomastowski *Nicolaus Copernicus University, Toruń, Poland*	**16.55**	*Not presented (abstract not included)* **Practices of Antibiotic Use and Detection of Residues in Chicken Meat: Analysis of the Poultry Sector in Haut Katanga (DRC)** Bady Mulumba Theddy, Mwewa Kapopo Christelle *University of Liège, Belgium*
17.02	**Study The Effect of *Aspergillus niger* on Pinus Seeds** Loay Mohammed Ali Mohammed Saeed Aoun, Jonas Žiauka *Vytautas Magnus University, Kaunas, Lithuania*	**17.02**	**Investigation of Sugar Beet Pulp Utilization for Bioethanol Production** Daiva Žadeikė, Žydrūnė Gaižauskaitė, Radvilė Bagdonavičiūtė *Kaunas University of Technology, Kaunas, Lithuania*
17.09	**Effect of Different Time Intervals of Ultrasound-Assisted Extraction on Polyphenolic Content of Dandelion Leaves** Taisa Vashkevich, Vilma Kaškonienė, Audrius Sigitas Maruška *Vytautas Magnus University, Kaunas, Lithuania*	**17.09**	**Effects of Natural and Chemical Additives on Alcohol Profile, Volatile Compounds, and Antioxidant Activity in Red Wine** Liepa Mockutė, Vilma Kaškonienė *Vytautas Magnus university, Kaunas, Lithuania*
17.14	**Evaluation of the Hydrodynamic Properties of Synthetic Monolithic Sorbents** Emilė Maneiko, Kristina Bimbiraitė-Survilienė *Vytautas Magnus university, Kaunas, Lithuania*	**17.14**	**Evaluation of Bioethanol Production from Coffee Spent Grounds Using Solid-State and Submerged Fermentation Processes** Sunil Kumar, Vilma Kaškonienė *Vytautas Magnus university, Kaunas, Lithuania*
17.20	***Discussions, Acknowledgements and Closing of the Session*** *(hybrid)* *Link 1: HYBRID participation*		

20th International Scientific Conference "The Vital Nature Sign"
Program

Friday, 15th of May 2026

Hybrid conference (in-person + online participation):

Venue: Vytautas Magnus University, Faculty of Natural Sciences, Universiteto St. 10, Room 154, Akademija, Kaunas District, Lithuania or **Microsoft Teams** *Link 1: HYBRID participation*

Online-only sessions

Microsoft Teams (Link 2) – *Link 2: ONLINE sessions*

Oral presentations *(hybrid)* *Link 1: HYBRID participation*

Session on Energy & Environment; Pharmaceutical and Chemical Technology; Synthetic, Medicinal and Pharmaceutical Chemistry; Biophysics and Biomedicine; Applied Physics

Chairpersons: Assoc. Prof. Dr. Nicola Tiso; Prof. Dr. Massimo Zacchini

8.45-9.00 (time zone GMT+3)	***Invited Speaker*** **From Chemical Signatures to Life Detection: Analytical Instrumentation for Exploration** Tomas Drevinskas *NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, United States*
9.00-9.15	**Control of the IVF Embryo Microenvironment: Temperature, pH, Gas Conditions, and Time-Lapse Monitoring as a Scientific Challenge** Domantas Armonavičius *Esco Medical Technology, Kaunas, Lithuania*
9.15-9.30	***Invited Speaker*** **Total Synthesis of Rhynchone A - Novel Lead for Male Contraceptives** Andrei V. Malkov, Jens Münchow, Louisa Temme *Loughborough University, UK*
9.30-9.45	**Microplastics in Organic Matter-Rich Soil Amendments: A Research Overview** Karolina Barčauskaitė, Dovilė Motiejauskaitė *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*
9.45-10.00	**Controlled Environment Cultivation: An Appropriate Technique for Medicinal and Aromatic Plants Growing** Nasim Safari, Akvilė Viršilė *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*
10.00-10.15	**Polyploidy-Driven Modulation of Drought Stress Responses in *Hemerocallis* L.: Insights from Integrated Molecular and Physiological Analyses** Edvinas Misiukevičius, Ingrida Mažeikienė, Birutė Frercks, Vidmantas Stanys *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*
10.15-10.30	**Temporal Shifts in The Plasma Lipidome During the Subacute Phase of Recovery Following Myocardial Infarction** Wojciech Łuczaj, Marcin Myszko, Elżbieta Skrzydlewska, *Medical University of Białystok, Białystok, Poland*

10.30-10.45 ***Coffee break***

Session on Energy & Environment; Pharmaceutical and Chemical Technology; Synthetic, Medicinal and Pharmaceutical Chemistry; Biophysics and Biomedicine; Applied Physics

Chairpersons: Dr. Karolina Barčauskaitė; Assoc. Prof. Dr. Vilma Kaškonienė

Link 1: HYBRID participation

10.45-11.00	**The Imbalance of Selected Ions Concentration as a Mediator of Cell Death** Sylwia Terpilowska *Jan Kochanowski University, Kielce, Poland*
11.00-11.15	**Nettle (*Utrica dioica* L.) Slurry as a Plant Biostimulant: Interactions with Mineral Nitrogen and Effects on Growth Traits and Soil Dehydrogenase Activity in Spring Wheat** Sidra Tul Muntaha, Vita Tilvikienė, Modupe Olufemi Doyeni *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*

11.15-11.30 (time zone GMT+3)	**Differences in the Meconium Microbiome Profile in Very Low-Birth Weight Preterm Newborns and Full-term Newborns** Milena Mirow, Darja Nikitina, Jurgita Gailiene, Vilma Ivanauskienė, Vaida Aleksejūnė, Ugnė Krunkaitytė, Ilona Aldakauskienė, Aušra Lukošiūtė-Urbonienė, Inga Dekerytė, Jurgita Skieceviciene, Rasa Tamelienė, Juozas Kupcinskas *Lithuanian University of Health Sciences, Kaunas, Lithuania*
11.30-11.45	**Development and Modeling of Nutraceutical Compositions Based on Technologically Functionalized Pea Proteins and Spirulina (*Arthrospira platensis*)** Emilis Radvila, Dovile Klupsaite, Ernestas Mockus, Vytaute Starkute, Elena Bartkiene *Lithuanian University of Health Sciences, Kaunas, Lithuania*
11.45-12.00	**Development of Protein-Enriched Crackers Incorporating Milk Protein Concentrate and Fermented Oat Milk By-Products** Nagoori Khadar Basha, Jūratė Malinauskienė, Loreta Šernienė *Lithuanian University of Health Sciences, Kaunas, Lithuania*
12.00-12.15	**Quality of Hunted Boar and Beaver Meat Applying Biological Treatment with Different Lactic Acid Bacteria** Vilija Buckiunienė, Austeja Gruzdaite, Vita Lele, Jolita Sarkauskiene, Dovile Klupsaite, Simas Grauzys, Elena Bartkiene *Lithuanian University of Health Sciences, Kaunas, Lithuania*
12.15-12.30	**Environmental Bioenergy Potential and Biomass Productivity of Hybrid Populus Clones under Northern European Conditions** Yanal Alkuddsi, Marius Aleinikovas, Benas Silinskas, Mohamad Alahmad, Abdul Monim Abdul Hafe, Ibrahim Alghoraibi, Mindaugas Skema, Lina Beniusiene, Valda Gudynaite, Yaser Thalji, Saeed Saado *Lithuanian Research Centre for Agriculture and Forestry, Kaunas, Lithuania*

12.30-13.30 ***Lunch break***

Oral presentations *(hybrid)* *Link 1: HYBRID participation*

Session on Energy & Environment; Pharmaceutical and Chemical Technology; Synthetic, Medicinal and Pharmaceutical Chemistry; Biophysics and Biomedicine; Applied Physics

Chairpersons: Dr. Baltramiejus Jakštys; Dr. Yanal Ahmad Alkuddsi

13.30-13.45	**Intracellular Macromolecule Loss as a Key Determinant of Cell Fate Following Irreversible Electroporation in CHO-K1 Cells** Anusiya Panneerselvam, Baltramiejus Jakštys, Saulius Šatkauskas *Vytautas Magnus university, Kaunas, Lithuania*
13.45-14.00	**Applying RSM and ANFIS Modeling with Machine Learning Algorithm Optimization Techniques to Extract Phenolic Compounds from the Olive Leaves of Chemlal Algerian Variety with Natural Deep Eutectic Solvent** Fatiha Brahmi, Lokesh Kumar Ramasamy, Selvaraj Kunjiappan, Hayate Guemghar-Haddadi, Kahina Djaoud, Lila Boulekbache-Makhlouf, Federica Blando *University of Bejaia, Algeria*
14.00-14.15	**Chronic Kidney Disease Early Prediction Using Machine Learning** Sarah Alnokta, Yanal Alkuddsi *Syrian Virtual University, Damascus, Syria*
14.15-14.30	**The Role of Bioinformatics in Determining the Genes Responsible for Certain Hereditary Dental Diseases** Karla Majed Ziade and Yanal Ahmad Alkuddsi *Syrian Virtual University, Damascus, Syria*
14.30-14.45	**Phylogenetic Analysis of *Leishmania infantum* Discovered in Syrian Coastal Province Using Bioinformatic Tools** Moayad Alresli, Yanal Alkuddsi, Chadi Soukkarieh, Ibrahim Alghoraibi, Abdul Monim Abdul Hafez, Ahmad Ismael and Issa Yusuf *Syrian Virtual University, Damascus, Syria*
14.45-15.00	**Prediction of Brain Stroke Using Machine Learning Algorithms** Hala Abdullah Aboud and Yanal Ahmad Alkuddsi *Syrian Virtual University, Damascus, Syria*
15.00-15.15	**In vitro Cytotoxicity of Cellulose Nanocrystals Derived from *Greenwayodendron suaveolens*** Abolaji Abiodun Mafolasire, Raminta Rodaitė, Laura Kairytė, Karolis Gedvilas, Babatunde Oluwole Ogunsile *University of Ibadan, Ibadan, Nigeria.*

15.15-15.30 **Coffee break**

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15.30 (time zone GMT+3) Flash presentations II.

Session on Energy & Environment; Pharmaceutical and Chemical Technology; Synthetic, Medicinal and Pharmaceutical Chemistry; Biophysics and Biomedicine; Applied Physics

	Parallel session (hybrid): *Link 1: HYBRID participation*		***Parallel session (only online):*** *Link 2: ONLINE sessions*
	Chairpersons: Dr. Paulius Ruzgys; Dr. Mantas Stankevičius		***Chairpersons: Assoc. Prof. Dr. Simona Sutkuvienė; Dr. Rūta Mickienė***
15.30	**From Extraction to Anticancer Potential: Phytochemical Profiling and Bioactivity Evaluation of Ellagic Acid-Rich Medicinal Plants** Domantas Armonavičius, Audrius Maruška, Kristina Bimbiraitė-Survilienė, Mantas Stankevičius, Baltramiejus Jakštys, Elžbieta Skrzydlewska, Ona Ragažinskienė, Vilma Kaškonienė, Saulius Šatkauskas, Arvydas Kanopka *Vytautas Magnus University, Kaunas, Lithuania*	**15.30**	**Efficient Red Phosphorescent OLEDs Enabled by Benzophenone–Carbazole Co-Host Materials** Gintare Krucaite, Dovydas Blazevicius, Raminta Beresneviciute, Saulius Grigalevicius, Yi-Qi Chao, Zih-Ru He, Kuan-Yu Su, Chih-Hao Chang *Kaunas University of Technology, Kaunas, Lithuania*
15.37	**Formulation and Biopharmaceutical Evaluation of Oleogels with Naftifine HCl** Faisal Habib Patel, Indrė Šveikauskaitė-Radučienė *Lithuanian University of Health Sciences, Kaunas Lithuania*	**15.37**	**Novel 3-Ethylcarbazole-Based Host Materials for High-Efficiency OLEDs** Saulius Grigalevicius, Dovydas Blazevicius, Mantas Kirstukas, Raminta Beresneviciute, Chih-Hung Ko, Cai-Fan Lo, Chih-Hao Chang *Kaunas University of Technology, Kaunas, Lithuania*
15.44	**Environmental and Physical Determinants of Climate-Induced Vulnerability: Situational Perspective of Kamalamai Municipality, Sindhuli, Nepal** Goma Sigdel, Chandra Lal Pandey, Reshma Shrestha, Vytis Cubrinskas, Pranjal Basnet, Karuna Kafle *Kathmandu University, Kathmandu, Nepal*	**15.44**	*Not presented (abstract not included)* **Non-Destructive Detection of *Fusarium oxysporum* Using Infrared Thermography** Benas G. Urbonavičius, Titas Dobilevičius *Kaunas University of Technology, Kaunas, Lithuania*
15.51	**Durable PVB-Based Nanocomposite Coatings: The Role of Surface Free Energy in Sustained, Multi-Functional Antimicrobial Efficacy** Mindaugas Ilickas, Asta Guobienė, Brigita Abakevičienė *Kaunas University of Technology, Kaunas, Lithuania*	**15.51**	**Repurposing of Commercial Hydrogen Fuel Cells** Benas G. Urbonavičius, Matas Bašinskas *Kaunas University of Technology, Kaunas, Lithuania*
15.58	**Changes in Some Chlorophyll Fluorescence Indices of Barley Due to Exposure to Millimeter-Sized PET Particles** Sanmugavel Saravana, Irena Januškaitienė, *Vytautas Magnus University, Kaunas, Lithuania*	**15.58**	**Carbazole-Benzocarbazole Fragments Having Derivative as Very Efficient Host Material for TADF Based OLEDs** Daiva Tavgenienė, Sushanta Lenka, Hsuan-Min Wang, Jayachandran Jaykumar, Dovydas Blazevicius, Gintare Krucaite, Yu-Lin Chi, Saulius Grigalevicius, Jwo-Huei Jou *Kaunas University of Technology, Kaunas, Lithuania*
16.05	**Evaluation of Combined Electroporation, Chemotherapy, and Immunotherapy in a Triple-Negative Breast Cancer Murine Model** Diana Šiurnaitė, Greta Chlebopaševienė, Paulius Ruzgys, Saulius Šatkauskas *Vytautas Magnus University, Kaunas, Lithuania*	**16.05**	**Cyanopyridine-Based Compounds as Green TADF Emitters and Sensitizers for Efficient NIR Emission** Dovydas Blazevicius, Daiva Tavgeniene, Gintare Krucaite, Raminta Beresneviciute, Saulius Grigalevicius, Szu-Jung Wang, Zhi-Yu Yuan, Chen-Hao Chang, Chih-Hao Chang *Kaunas University of Technology, Kaunas, Lithuania*

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Parallel session (hybrid): *Link 1: HYBRID participation*		***Parallel session (only online):*** *Link 2: ONLINE sessions*	
16.12	**Research on the Distribution of Electric Field in Tissues After Electric Field Application** Karthickeyan Kalimuthu Senthurvadivel, Baltramiejus Jakštys, Saulius Šatkauskas *Vytautas Magnus university, Kaunas, Lithuania*	**16.12**	**Novel 3-(Diphenylamino)carbazole Compounds for Green TADF OLEDs** Raminta Beresneviciute, Inesa Sasnauskaite, Zeyad Taher Abdou, Dovydas Blazevicius, Saulius Grigalevicius, Wanting Ju, Xiangqin Gan, Junqiao Ding, Kaspars Traskovskis *Kaunas University of Technology, Kaunas, Lithuania*
16.20	**Genetic Diversity of Lithuanian Populations of *Impatiens glandulifera* Royle** Rasa Rukuižaitė, Lina Jocienė, Eugenija Kupčinskienė Vytautas Magnus university, Kaunas, Lithuania	**16.20**	**Tailoring Non-Linear Optical Properties of Dicyanoisophorone Derivatives via Donor-Modulation** Khushdeep Kaur, Weizhen Liu, Yovan de Coene, Koen Clays, Kamaljit Singh, Asta Dabuliene, Juozas Vidas Grazulevicius *Kaunas University of Technology, Kaunas, Lithuania*
16.27	**Intraspecific Genetic Variation in Lithuanian Populations of *Impatiens noli-tangere* L. and Interspecific Comparison with Congeners** Rūta Budrevičiūtė, Lina Jocienė, Eugenija Kupčinskienė *Vytautas Magnus university, Kaunas, Lithuania*	**16.27**	**Functionalized *p*-Phenylenediamines as Efficient Hole-Transporting Materials for Optoelectronic Applications** Svetlana Sargsyan, Mariia Stanitska, Melika Ghasemi, Dmytro Volyniuk, Oleksandr Bezvikonnyi, Viktorija Andrulevičienė, Juozas Vidas Gražulevičius *Kaunas University of Technology, Kaunas, Lithuania*
16.34	**Genetic Diversity of *Anthemis trotzkiana* Claus Populations in Kazakhstan** Aida Šiupšinskaitė, Klara Izbastina, Lina Jocienė, Edvina Krokaitė, Eugenija Kupčinskienė *Vytautas Magnus university, Kaunas, Lithuania*	**16.34**	**Statistical and Technical Analysis for Human Activity Recognition using Smart Phone** Hala Issam Saraya, Yanal Ahmad Alkudsi *Syrian Virtual University, Damascus, Syria*
16.41	**Assessment of Genetic Variation in *Impatiens parviflora* DC. Populations** Vaida Jasionytė, Lina Jocienė, Eugenija Kupčinskienė *Vytautas Magnus university, Kaunas, Lithuania*	**16.41**	**Contamination of Fresh and Dried Lithuanian Apples with Micromycetes and Evaluation of Essential Oils Antifungal Activity** Kotryna Chramkovaitė, Rūta Mickienė, Audrius Sigitas Maruška *Vytautas Magnus University, Kaunas, Lithuania*
16.48	**Modulatory Effects of Calcium Electroporation and H-FIRE Waveforms on H9c2 Cell Viability and Membrane Permeabilization** Aras Rafanavičius, Saulius Šatkauskas *Vytautas Magnus University, Kaunas, Lithuania*	**16.48**	**Dynamics of Micromycete Distribution in Bread Products and Their Control Methods** Gabija Paškevičiūtė, Rūta Mickienė, Audrius Sigitas Maruška *Vytautas Magnus University, Kaunas, Lithuania*
16.55	**Effect of Cell Culture Additives on Aggregation of SARS-CoV-2 Nucleocapsid Protein with RNA.** Arnas Treimakas, Indrė Kučinskaitė-Kodzė *Vilnius University, Vilnius, Lithuania*	**16.55**	**Plant Secondary Metabolites – Protection Against Airborne Microorganisms** Jūratė Veršinskaitė, Rūta Mickienė, Audrius Sigitas Maruška *Vytautas Magnus university, Kaunas, Lithuania*
17.05 Discussions, Acknowledgements and Closing of the Session (hybrid Link 1: HYBRID participation)			

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ORAL PRESENTATIONS

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ISSN:2335-8653
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ORAL PRESENTATIONS

SPECIAL SESSION ON CLIMATE CHANGE AND SUSTAINABLE CONSTRUCTION

ISSN:2335-8653
ONLINE ISSN: 2335-8718

FLASH PRESENTATIONS

ISSN:2335-8653
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ORAL PRESENTATIONS

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Invited Lecture

Advancing Sustainable Liquid Chromatography: Green Solvents, Method Optimization, and CoreShell Innovations

Egidijus Machtejevas

Life Science, Chemistry, Analytical Chemistry, Merck Life Science KGaA, Darmstadt, Germany.

Abstract

Liquid chromatography is essential across industries, but conventional LC often uses hazardous solvents and large columns. This talk outlines practical strategies to reduce solvent use and waste without sacrificing performance. Key levers include green mobile phases (water, ethanol, bio-based solvents; recyclable options like bioethanol; consider supercritical CO2 where suitable) and reduced-column dimensions with optimized gradients. Green instrumentation and sustainability-minded supplier choices further cut footprint, while alternative methods (capillary electrophoresis, SFC) are considered when greener solvents aren't feasible.

Method-level strategies include shortening columns, lowering injection volumes, and refining gradients, plus leveraging complementary modes (RPLC, HILIC, PGC) and 2D-LC to maintain separations with less solvent. Highlights feature rapid nucleoside separations using Purospher STAR RP-18e and SeQuant ZIC-HILIC in 2D-LC for proteomics, robust retention studies on carbon columns for glycan profiling, and insights into glycan/oligo retention.

CoreShell (superficially porous) particles maximize efficiency and reduce solvent needs; new Ascentis Express and BIOshell columns offer improved peak shapes, high-pH stability, and enhanced separation of hydrophilic, bio-related molecules. Takeaways: actionable, greener LC workflows for OMICS, glycomics, and proteomics.

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Invited Lecture

Water-Soluble Synthetic Polymers (WSSPs) as Emerging Concern for the Aquatic Environment: A Preliminary Study on the Effects of Polyvinylpyrrolidone (PVP) on Animal and Plant Bioindicators

Valentina Iannilli[1], Samuele Terranegra[1], Francesca Lecce[1], Laura Passatore[2], Serena Carloni[2], Anna Wyrwicka-Drewniak[3], Grazyna Chwatko[4], Fabrizio Pietrini[2], Massimo Zacchini[2]

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Abstract

Polyvinylpyrrolidone (PVP) is one of the most widely used water-soluble synthetic polymers (WSSPs), often referred to as "liquid plastics", due to its versatile, biocompatible, film-forming and amphiphilic properties. It is increasingly employed in personal care products, in water treatment processes, novel bioplastics, and antimicrobial films. In addition, its low biodegradability and lack of specific regulation represent a concern about its environmental fate, especially in vulnerable ecosystems like the aquatic environment [1]. So far, the effects of WSSPs presence on aquatic biota have been poorly studied, with *Daphnia magna* targeted as a model species [2]. No studies have been reported concerning the effects of WSSPs on three representatives freshwater bioindicator species: the amphipod *Echinogammarus veneris* and the aquatic macrophytes *Lemna minor* and *Spirodela polyrhiza*. Therefore, two sets of experiments targeting these organisms were carried out, exposing the amphipods to 0, 1, 5, 10, 50 mg/L PVP dissolved in natural water in beakers for 24h at 15 °C (L/D 12/12) and the plants in multiwell plates to 0, 5, 10, 50 mg/L PVP in Hoagland solution for 7 days at 25 °C (L/D 16/8), as for previous investigations [3]. Results showed that PVP caused a concentration-dependent increase in genotoxic effect in gammarids, while the ventilatory activity significantly increased only at the two highest PVP concentrations. Contrarily, no toxic effects of PVP were observed on macrophytes at biometric and physiological levels. Particularly, no changes in the pigment content and photosynthetic activity, measured by spectral reflectance and chlorophyll fluorescence, respectively, were detected at any PVP concentration tested. A protocol is currently being set up to quantify the chemical compound in nutrient solutions and biological samples using high-performance liquid chromatography (HPLC), as no reports on the quantification of PVP in the aquatic organisms tested in this study have yet been produced.

Keywords: aquatic plants, duckweed, gammarids, HPLC-UV, microplastics, photosynthesis.

References:

[1] C. Robison-Smith, et al., Science of the Total Environment 2024, 907, 168086
[2] E.C. Tarring, et al., Science of the Total Environment 2025, 983, 179686
[3] V. Iannilli, et al., Water 2023, 15(5):921

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Invited Lecture

Impact of Selenium Biofortification on the Glucosinolate Profile and Secondary Metabolism of Savoy and Tuscan Cabbage

Enrica Donati[1], Zeineb Aturki[1], Giovanni D'Orazio[1], Lázaro-Armando Pérez-Acosta[2], Mercè Llugany[3], María-Jesús Sánchez-Martín[2], Danilo Corradini[1]

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Abstract

Selenium (Se) deficiency in the diet can lead to severe physiological disorders in both humans and livestock, such as organ and tissue degeneration, thyroid dysfunction, and compromised reproductive performance. Daily selenium intake in human depends on its content in food, which in turn is largely determined by the bioavailability of selenium in the soil where edible plants and crops are grown. Consequently, agronomic biofortification with selenium has emerged as an effective approach to addressing selenium deficiencies in the diet, since plants can convert inorganic selenium into bioavailable forms, such as selenoproteins. Recent research suggests that selenium biofortification modulates plant secondary metabolism, thereby affecting the biosynthesis and accumulation of bioactive compounds, including phenolic compounds, chlorophylls, and carotenoids [1].

In this regard, the present study aimed to investigate the influence of selenium biofortification on the biosynthesis and accumulation of health-promoting phytochemicals in two cabbage varieties, specifically Savoy and Tuscan Cabbage. Particular focus was placed on glucosinolates (GSLs), nitrogen- and sulfur- containing compounds that serve as quality markers for plants belonging to the *Brassicaceae* family. Both cabbage varieties received selenium-enrichment by foliar applications of either selenite (Se[IV]) or selenate (Se[VI]) solutions [2]. Samples were extracted from lyophilized leaves of treated and untreated plants using 70% (v/v) aqueous methanol at 70 °C for 30 min. Untargeted metabolomic profiling was performed by UPLC-PDA using an Acquity UPLC HSS T3 column, employing a binary gradient of water and acetonitrile, both containing 0.1% (v/v) formic acid. Chromatographic fingerprints were recorded at 227 nm and 330 nm to monitor Se-induced variations. A comparison of the chromatographic profiles showed significant changes in the abundance of several peaks, indicating that Se-enrichment notably influenced the plant's chemical composition. Subsequently, a targeted metabolomic approach using UHPLC-MS/MS was employed to identify and quantify the specific secondary metabolites showing significant Se-induced variations.

Keywords: selenium biofortification, *Brassica oleracea*, secondary metabolism, glucosinolates, UHPLC-MS/MS.

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References:

[1] Y. Luo, et al., Physiology and Molecular Biology of Plants 2024, 30 (10), 1643-1657. https://doi.org/10.1007/s12298-024-01513-x.
[2] M. Viltres-Portales et al. Food Chem. 2024, 448, 139123. https://doi.org/10.1007/s12298-024-01513-x.

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Invited Lecture

Single Cell Proteomics – Quo Vadis?

Ákos Végvári

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Abstract

During the last five years, single cell proteomics (SCP) has been dynamically developed to a fresh area of analytical chemistry. Today, we have numerous methods and workflows introduced to both sample preparation and data acquisition, while data analysis is still an emerging area. Since the latest generation of mass spectrometers offer sufficient sensitivity required for SCP, sample preparation remains to be the most critical part of the analysis. Isobaric labelling based multiplexing has gained importance affording good throughput but limited by multiple step preparation that can lead to substantial sample loss. Alternatively, label-free SCP has been developed, which demands short analysis time to cope with throughput and detection by very sensitive mass spectrometers.

On one hand, such diversity of approaches is a promising sign for long term establishment of methodologies offering flexibility to research groups and facilities as well as specific solutions to address various types of biological questions. On the other hand, the current state of SCP is strongly technologically driven searching for a research niche to prove its potential. Accordingly, we have developed and applied SCP to chemical proteomics, introduced single bacterium proteomics and demonstrated the power of the technique to detect xenoproteins in virus infected human cells. To address practical limitations, we currently work on improved quantification control exploring targeted protein analysis in data independent acquisition experimental designs.

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Invited Lecture

Total Synthesis of Rhynchone A - Novel Lead for Male Contraceptives

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Abstract

Rhynchone A is a structurally interesting and biologically relevant natural polyphenol isolated from plant *Rhynchosa volubilis* [1]. It was reported as a CatSper (Cation Channel of Sperm) agonist representing a promising target for male contraceptives. However, only small quantities of the material were isolated from the plant. A good, practical synthetic access is required to provide a sufficient amount of the compound to confirm the assigned structure and to investigate the structure-activity relationship. We report a convergent modular total synthesis of racemic Rhynchone A, featuring aromatic cross-coupling as a strategic bond construction that enables efficient assembly of the core scaffold. Our route proceeds in seven linear steps from readily available starting materials. The successful synthesis of Rhynchone not only confirms its structural assignment but also provides a platform for the preparation of analogues for future biological evaluation.

Keywords: total synthesis, polyphenols, CatSper agonist, synthetic methodology, coupling.

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In Vitro Cytotoxicity of Cellulose Nanocrystals Derived from *Greenwayodendron suaveolens*

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Abstract

Cellulose nanocrystals (CNCs) are renewable, biodegradable nanomaterials increasingly explored for applications in biomedicine, including drug delivery systems, tissue engineering scaffolds, and advanced biomaterials [1, 2]. They can be isolated from lignocellulosic sources such as *Greenwayodendron suaveolens (GS*), yet they possess high crystallinity, mechanical strength, and surface functionality. This makes them attractive candidates for designing bio-based materials with tailored properties [3]. However, as CNCs are intended for direct interaction with biological systems, their cytotoxicity and safety must be carefully evaluated. Therefore, this study aimed to investigate the cytotoxicity of CNCs isolated from *GS*.

Structural properties, crystallinity, morphology, and elemental distribution of CNCs obtained from *GS* were examined using FTIR, XRD, SEM, and EDS, respectively. Their cytotoxic effect was evaluated using an *in vitro* colony forming efficiency assay. Chinese hamster ovary (CHO) cells were used as a model system to assess cell survival and proliferative capacity after exposure to CNCs. This method enables the sensitive detection of long-term cellular damage by examining the ability of single cells to form colonies.

The absence of an absorption peak at 1731 cm^{-1} (C=O group) in the FTIR spectra of CNCs isolated from GS indicated the removal of non-crystalline constituents originally present in GS-cellulose. Characteristic peaks at 2θ values of 16.31° and 23.02° in XRD spectra confirmed the formation of nanocrystalline cellulose. SEM analysis revealed that the produced CNCs exhibit a well-defined crystalline structure with irregular aggregated morphologies. Furthermore, the observed microstructure was consistent with typical rod-like nanocrystals, which tend to form agglomerates due to strong intermolecular interactions and hydrogen bonding. Elemental analysis confirmed that the material is predominantly composed of carbon and oxygen, characteristic of cellulose-based nanomaterials. CNC exposure influenced colony formation, indicating a concentration-dependent effect on CHO cells. Changes in colony number and morphology revealed that CNCs did not induce cytotoxicity; instead, they promoted cellular viability and proliferative capacity, demonstrating their biocompatible behavior. CNCs isolated from *GS* exhibit high crystallinity, favorable morphology, and well-defined structural characteristics, along with good cytocompatibility, highlighting their potential for biomedical applications.

Keywords: cellulose nanocrystals, CNS, cytotoxicity, CHO cells, nanocellulose.

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Environmental Bioenergy Potential and Biomass Productivity of Hybrid *Populus* Clones under Northern European Conditions

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Abstract

This study evaluates the growth performance, biomass productivity, and associated bioenergy and carbon sequestration potential of 19 hybrid *Populus* clones originating from eight countries (Iceland, Sweden, Lithuania, the Netherlands, the United Kingdom, Serbia, Italy, and Greece) cultivated under northern European conditions in Lithuania. Hybrid *Populus* plantations are increasingly recognized as strategic lignocellulosic resources supporting renewable bioenergy systems and climate mitigation strategies within the European bioeconomy. Long-term field measurements collected in 2016 and 2025 were used to assess clonal performance using conventional dendrometric traits together with dynamic indicators including absolute change (Δ), mean annual increment (MAI), and compound annual growth rate (CAGR). The results revealed pronounced genetic differences among clones already at early developmental stages. In 2016, diameter at breast height (DBH) ranged from 3.89 to 6.64 cm, tree height from 3.0 to 5.99 m, and stem volume from 0.0028 to 0.0104 m³. By 2025, DBH increased to 8.75–22.31 cm and stem volume reached up to 0.3845 m³, confirming substantial variation in growth trajectories among clones. The Swedish clone SvSF Po11 showed the highest performance, with a final stem volume of 0.3845 m³, absolute volume increment (ΔV) of 0.3815 m³, and CAGR of 0.715. When biomass productivity was integrated with energy and carbon indicators, clear differences among clones were observed. The most productive clone (SvSF Po11) reached 456.9 t ha^{-1} of biomass, corresponding to a theoretical bioenergy potential of 8482 GJ ha^{-1} (2356 MWh ha^{-1}) and a carbon sequestration capacity of 838 t CO_2 ha^{-1}. Other highly productive clones included SvSF Po12 and Nyd3261-Degrosso, which achieved approximately 81% and 77% of the maximum biomass productivity, respectively. In contrast, the lowest productivity was recorded for Ser18281 and Gra-Italy-1, which produced only 15–16% of the biomass of the best-performing clone. A strong relationship between DBH and stem volume confirms the reliability of DBH as a practical proxy for biomass estimation in operational forestry systems. Integrating growth dynamics with biomass-based energy and carbon indicators provides a robust framework for identifying high-performing genotypes suitable for sustainable biomass production, renewable bioenergy supply, and climate mitigation strategies in northern European forestry and circular bioeconomy systems. Regression analysis demonstrated that dendrometric traits are significantly related to biomass productivity, with DBH showing the strongest predictive relationship for biomass estimation in hybrid *populus* plantations. These results emphasize the environmental significance of hybrid poplar plantations as efficient renewable biomass resources capable of supporting sustainable bioenergy production while contributing to carbon mitigation and the broader transition toward low-carbon bioeconomy systems in Europe.

Keywords: hybrid *Populus*, bioenergy potential, biomass productivity, carbon sequestration, dendrometric indicators, renewable energy systems, climate mitigation, Northern Europe forestry.

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Early Detection of Chronic Kidney Disease Using Advanced Machine Learning Approaches

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Abstract

The kidneys play a vital role in maintaining human health by removing metabolic waste and toxins from the bloodstream. Chronic kidney disease (CKD) is a progressive condition characterized by the gradual loss of kidney function, ultimately impairing the body's ability to effectively filter blood. As a non-communicable disease, CKD represents a major global health burden, particularly in low-resource settings where early diagnosis remains challenging and costly. Consequently, many patients are diagnosed at advanced stages of the disease. One of the critical challenges associated with CKD is its asymptomatic nature during the early phases, which often leads to delayed detection. Despite the absence of clear clinical symptoms, a continuous decline in the glomerular filtration rate (GFR) occurs over an extended period exceeding three months. If left untreated, CKD may progress to end-stage renal failure, posing serious health risks. Early identification of CKD is therefore essential, as it significantly improves treatment outcomes and enhances patient survival rates. In recent years, machine learning (ML) techniques have emerged as powerful tools for medical prediction and decision support. Their ability to analyze complex datasets and identify hidden patterns makes them particularly valuable in nephrology for detecting individuals at risk. This study proposes a predictive framework based on machine learning for the early detection of CKD. Specifically, the XGBoost algorithm, a robust boosting technique, is employed to achieve high predictive performance. To enhance model efficiency, comprehensive data preprocessing procedures were applied, including feature selection and hyperparameter optimization. Additionally, the relative importance of input features contributing to CKD prediction was analyzed. The model's performance was evaluated using accuracy as the primary metric, achieving an overall accuracy of 98% on both training and testing datasets. These findings highlight the potential of advanced machine learning models as effective tools for early CKD detection, offering promising opportunities to improve clinical decision-making and patient outcomes in kidney disease and related medical fields.

Keywords: chronic kidney disease, XGBoost, predictive modelling, early detection, machine learning, feature selection, clinical decision support, data analytics.

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Phylogenetic Analysis of *Leishmania infantum* Discovered in Syrian Coastal Province using Bioinformatic Tools

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Abstract

Leishmaniasis has a long history, dating to 2,500 B.C., with several initial indications of the disease. The three basic clinical forms of *Leishmania*: cutaneous leishmaniasis, mucosal leishmaniasis, and visceral leishmaniasis constitute a major global public health problem. The history of leishmaniasis in Syria dates back hundreds of years. Two types of leishmaniasis are widespread in Syria: cutaneous leishmaniasis and visceral leishmaniasis, which is caused by *Leishmania infantum*. Understanding the evolution of the genus *Leishmania* is critical for improving diagnosis, prognosis, and treatment and control decisions. Internal transcribed spacers (ITS1) are used to distinguish species belonging to the different Leishmania complexes. Three *L. infantum* isolates were identified in patients who were visiting the Leishmania Treatment and Diagnosis Center in Lattakia. Then a phylogenetic study and haplotype analysis were conducted based on their (ITS1). To study the phylogenetic relationships among *L. infantum* isolates with other Leishmania species reference sequences retrieved from GenBank. In addition to determining the level of variation among ITS1 among genus Leishmania groups and visualizing these variations by constructing the haplotype network. This study utilized the Genebank database, to retrieve reference ITS1 sequences of Leishmania species, MEGA v.11.0 programm, was used to infer the genetic divergency and to construct two phylogenetic trees among the 40 sequences included three sequences from our study "A01,C01,E01", using neighbour-joining algorithm (NJ) and maximum likelihood (ML) algorithm. Trees were then visualized using the "ggtree" R package. The number of polymorphic sites was measured using DnaSPv5.0 software. A median-joining haplotype network was constructed using POPART software v.1.7 . NJ and ML trees represent three main clusters. The main cluster, where *L. donovani* complex clustered with *L. infantum* into two basic clades, A low rate of divergency with a genetic distance of 0.0606 was found between *L. infatum* groups and *L. donovani* group, which is explained by the fact that both species are categorized in the same *L. donovani* complex (alkoundi 2017), while the genetic distance between *L. infatum* group and *L. tropica* group was 0.2808. 13 haplotypes with 80 polymorphic sites were found with haplotype diversity (Hd:0.677), The *L. infantum* group was identified by 4 haplotypes, with the lowest haplotype diversity (Hd =0.284). To our knowledge, this is the first phylogenetic analysis of *L. infantum* isolates from patients residing in the Syrian province that demonstrates genetic variation and haplotype analysis. Further phylogenetic and haplotype studies are needed in our country to explain the genetic variants and discriminate more polymorphic sites in the sequences of new *Leishmania* cases. Thus, to clarify the risk status and evaluate the burden of this visceral parasite in Syria and neighbouring regions. An accessible database may be created to facilitate the exchange of information and integrate a common analysis of the data obtained by different researchers. Therefore, apply adequate case management for this parasite in this region and strengthen local epidemiological surveillance programs.

Keywords: Leishmaniasis, *Leishmania infantum*, ITS1, phylogenetic analysis, haplotype network, genetic diversity.

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Skin Cancer Prevention and Treatment with Natural Compounds: Is It Real?

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Abstract

Ultraviolet radiation (UV) exposure can lead to both direct and indirect damage to human skin. It can cause specific DNA mutations as well as oxidative damage to macromolecules (proteins and lipids), altering intracellular signalling, disrupting cellular homeostasis and metabolism, and ultimately contributing to the development of skin cancers, including the deadliest form, melanoma [1]. Although melanoma represents a small percentage of skin cancers, it has the highest mortality due to its complex biology and limited effectiveness of conventional therapies [2–4]. Moreover, a growing concern exists about the rising risk of skin cancer due to climate change factors, including increased cumulative UV exposure [5,6]. Thus, there is an urgent need to develop novel protective and therapeutic strategies.

Extensive research highlights the potential of natural compounds with anticancer, preventive, and regenerative properties. Given the regulatory role of redox metabolism in skin cancer development and prognosis, phenolic (natural) compounds were identified using two criteria, based on data collected between 2005 and 2025: (1) their ability to modulate intracellular redox balance and inflammatory signaling, causing metabolic changes; and (2) evidence of protective or therapeutic effects in skin cancers (including basal cell carcinoma, squamous cell carcinoma, and melanoma) from *in vitro*, *in vivo*, or clinical studies. Because of limited data on skin cancer, evidence from other cancers was included, particularly concerning the molecular regulatory roles of these compounds.

The natural compounds catechins, procyanidin C1, piperitoside, and mulberrofurans have demonstrated promising potential owing to their ability to regulate redox signalling and inflammation, processes that are critical in skin cancer prevention and treatment. Catechins and procyanidin C1 stand out for their tumour growth–inhibitory and antifibrotic properties, respectively. The involvement of piperitoside in modulating the skin microbiome, an important factor in skin carcinogenesis, as well as the cytotoxic activity and regulatory effects of mulberrofurans on protein aggregation, support their further investigation in skin cancer research. In light of this, these compounds warrant comprehensive investigation in both melanoma and non-melanoma skin cancers.

Keywords: UV radiation, skin cancer, natural compounds, oxidative stress, inflammation.

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Microplastics in Organic Matter-Rich Soil Amendments: A Research Overview

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Abstract

Microplastic contamination in waste-derived materials such as compost, digestate, and sewage sludge has become a critical environmental and public health issue as these materials are directly incorporated into the soil and could influence plant growth and enter the food chain [1]. Although Lithuania and the wider Baltic region increasingly promote the circular use of organic secondary raw materials in agriculture, there is currently no harmonised, validated analytical capacity for detecting and characterising microplastics in organic soil amendments. As a result, risk assessments, regulatory decisions, and safe reuse strategies remain largely based on predictions rather than reliable data. The Lithuanian Research Centre for Agriculture and Forestry (LAMMC) Agrobiology Laboratory is currently conducting research focused on the occurrence, characterization, and impacts of microplastics in organic matter–rich soil amendments. Particular attention is given to materials such as sewage sludge, digestate, compost and soil, which are widely related to agricultural systems and human health [2,3]. An overview of this research performed at LAMMC Agrobiology laboratory, along with the analytical methods used for microplastic detection, quantification, and identification, will be presented during the conference.

Keywords: microplastics, organic soil amendments, pyrolysis gas chromatography-mass spectrometry, μRaman.

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Regulatory Role of Phytocannabinos on Relation to Melanocyte Lipid Metabolism

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Abstract

Melanocytes are skin cells responsible for melanin production; however, metabolic alterations induced by UVA radiation may lead to neoplastic transformation and the development of melanoma. Therefore, this study assessed the effects of phytocannabinoids: cannabidiol (CBD), cannabigerol (CBG), and their combination (CBD+CBG) on melanocytes previously exposed to UVA radiation. Both CBD and CBG were shown to effectively penetrate melanocytes, localizing primarily in cell membranes. UVA radiation alters the intracellular distribution of phytocannabinoids and disrupts redox homeostasis, as evidenced by reduced total antioxidant status (TAS) and increased markers of oxidative stress, including lipid peroxidation product malondialdehyde (MDA). However, treatment with CBG or the CBD+CBG combination partially mitigates these oxidative changes. UVA radiation also induces significant alterations in membrane lipid composition, including phospholipids and free polyunsaturated fatty acids (PUFA).

These effects are partially attenuated by CBD and CBG. Furthermore, phytocannabinoids influence the fatty acid oxidation pathways mediated by cyclooxygenases (COX-1 and COX-2) and partially reverse the UVA-induced decrease in endocannabinoid levels (AEA, 2-AG, and PEA). Changes in the eicosanoid profile are also observed, including a reduction in pro-inflammatory mediators (PGE2, PGD2, 5-HETE, 12-HETE) and an increase in the anti-inflammatory mediator 15-d-PGJ2. These changes are accompanied by modulation of the expression of membrane receptors (CB1, CB2, TRPV1, and PPARγ) which are affected by UVA radiation. Notably, CBG increases the expression of all tested receptors, whereas CBD and the CBD+CBG combination exert a more selective effect, primarily influencing TRPV1 and PPARγ expression. In summary, phytocannabinoids partially restore redox balance and alleviate inflammatory responses. Consequently, the obtained results suggest a regulatory and potentially protective role of phytocannabinoids in melanocytes exposed to UVA-induced stress, which may be relevant for the mechanisms counteracting possible neoplastic transformation.

Keywords: melanocytes, cannabidiol, cannabigerol, PUFAs metabolites, eicosanoids, endocannabinoids.

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Applying RSM and ANFIS Modeling with Machine Learning Algorithm Optimization Techniques to Extract Phenolic Compounds from the Olive Leaves of Chemlal Algerian Variety with Natural Deep Eutectic Solvent

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Abstract

The goal of the current study was firstly to create an environmentally friendly technique for recovering total phenolics (TP) from olive leaves of Chemlal variety by employing natural deep eutectic solvent (NADES). Secondary, the central composite design (CCD) in response surface methodology (RSM) was utilized to optimize the effective extraction parameters. The adaptive neuro-fuzzy inference system (ANFIS) and random forest regressor-machine learning (ML) algorithms were utilized to validate the optimized extraction parameters for the maximum yield of TP. The latter value of 95.00 ± 1.49 mg Gallic Acid Equivalent (GAE) /g Dry Matter (DM) was attained after a maceration during 90 minutes at a speed of 500 rpm, using a ratio of 1/70 g/mL. When compared to traditional RSM, the comparative results demonstrated that machine learning-based models offered improved generalization and higher prediction accuracy. The extraction process was particularly well-optimized by the XGBoost and ANFIS models, with time and solvent ratio were the most important variables. The optimized extract had flavonoid content of 0.52 ± 0.03 mg Quercetin Equivalent (QE)/g DM, and tannins content of 6.64 ± 0.30 mg Tannic Acid Equivalent (TAE)/g DM. Based on antioxidant tests, this extract have a potent antioxidant effect with IC_{50s} values of 194.165 µg/mL (phosphomolybdate), 3330 µg/mL (DPPH), and 9750 µg/mL (ABTS). Overall, this work demonstrated the best conditions and environmentally acceptable solvent to extract TP from Chemlal Algerian variety olive leaves. It also emphasizes that this strategy could be adopted to valorize olive by-products mainly in the food and cosmetic fields.

Keywords: olive leaves, phenolic compounds, optimization of extraction, antioxidant activity.

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Quality of Hunted Boar and Beaver Meat Applying Biological Treatment with Different Lactic Acid Bacteria

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Abstract
The application of lactic acid bacteria (LAB) in meat marination is an innovative biopreservation method that improves sensory properties, inhibits pathogenic microflora, and extends product shelf life through the production of lactic acid and bacteriocins. The aim of this study was to comprehensively investigate and compare the chemical, physical, and food safety parameters of fresh beaver and wild boar meat, as well as meat marinated with different LAB cultures. The analysis of technological parameters showed that after 24 hours of marination, pH decreased significantly in both meat types, from 5.6 to 5.1 in beaver meat and from 5.4 to 5.2 in wild boar meat. This acidification of the meat matrix caused partial muscle protein denaturation, which reduced water-holding capacity and proportionally increased cooking losses, reaching approximately 30–31% in both experimental groups. Regarding chemical composition, protein content in beaver meat remained stable (approximately 21–22%), whereas a slight decrease in protein concentration was observed in wild boar meat. From a nutritional perspective, a notable difference was observed in cholesterol levels: very high cholesterol content (on average 99 mg/g) was detected in fresh wild boar meat, while the corresponding value in beaver meat was about half as high (approximately 50 mg/g), confirming beaver meat as a healthier, more dietary option. Safety parameter analysis revealed that LAB treatment significantly reduced the levels of biogenic amines. Spermine and putrescine concentrations decreased significantly in both beaver and wild boar meat after marination, and the toxic biogenic amine histamine was completely eliminated in the beaver meat samples. However, a negative effect was also observed, as LAB marination stimulated lipid malondialdehydes concentration in meat. Malondialdehyde (MDA) levels increased significantly in both meat types. In wild boar meat marinated with *Pediococcus pentosaceus*, MDA increased by 54.5%, while in beaver meat experimental groups it increased by up to 68% ($p < 0.05$). In concluded, changes in chemical composition varied between species: in wild boar meat, protein content decreased while fat content increased, whereas in beaver meat, a slight increase in protein content was observed after marination. Overall, marination with *Lactobacillus* and *Pediococcus* strains is an effective method for acidifying the meat environment and reducing biogenic amines, thereby improving microbiological safety of the final product. Beaver meat, characterized by significantly lower cholesterol content than wild boar meat, represents a nutritionally more favorable alternative for health-oriented diets. However, due to increased MDA after marination, the technological process requires further optimization.

Keywords: wild boar meat, beaver meat, lactic acid bacteria, meat quality.

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Valorization of Sugar Beet Pulp through Fungal Fermentation: Effects of Pretreatment on Protein and Nutritional Quality

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Abstract

In this study, semi-solid fermentation (SmF) using filamentous fungi was evaluated as a sustainable, low-cost method to increase the protein value of sugar beet pulp (SBP) as a functional ingredient. The influence of ultrasonication (US) and hydrothermal (HT) pretreatments prior to SmF was assessed through nutritional and technological properties of the resulting SBP-fungal biomass. As a results of SmF with *Aspergillus nidulans* CCF2912, *Botrytis cinerea* CCF2361, and *Rhizopus arrhizus* CCF1502, the protein content was increased from 53.7 to 93.82–134.11 mg/g d.w. and the essential amino acid (EAA) ratio was increased from 0.81 to 1.96 in the fermented SBP. A post-fermentation heat treatment (90 °C, 30 min) allowed to reduce nucleic acids by 20.3–31.5% in the end product. The fatty-acid profile shifted toward higher unsaturation, with monounsaturated fatty acids increasing from 2.36% to 4.93% and polyunsaturated fatty acids from 5.11% to 10.16% of total fatty acids. Tryptic digestion followed by in silico screening indicated the presence of peptides (≤2 kDa) with predicted radical-scavenging potential against DPPH, hydroxyl, and $ABTS^{\bullet+}$ radicals. Among the tested strains, *R. arrhizus* CCF1502 cultivated on US-pretreated SBP produced the highest protein biomass yield and overall nutritional quality. Integration of pretreatment with SmF represents an efficient approach to elevate SBP into a protein-enriched ingredient with improved nutritional characteristics for food and feed applications.

Keywords: valorisation, food science, mycoproteins.

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Analysis Of Berry Superfruits For Total Thiol Content By LC-UV-Based Method

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Abstract

"Superfruits" is a commercial designation referring to unprocessed, genetically unmodified fruits of natural origin that are exceptionally rich in essential nutrients with pro-health effects on the human body [1,2]. Despite the widespread appeal of functional foods valued for their physiological benefits, comprehensive data regarding their qualitative and quantitative composition are scarce. Moreover, detailed information regarding the individual bioactive molecules that drive these health benefits remains limited. Although superfruits contain a diverse range of compounds, research has predominantly focused on monitoring vitamins, minerals, and antioxidants [1,2] with polyphenols being the most extensively studied group.

Low-molecular-mass sulfur-containing compounds, notably glutathione (GSH), cysteine (Cys), cysteinyl-glycine (Cys-Gly), and homocysteine (Hcy), are well-established antioxidants that play a crucial role in maintaining cellular redox homeostasis [3]. Although berry fruits are famed for their antioxidant properties, they have not yet been comprehensively investigated to characterize the full spectrum of these relevant thiols. Their specific thiol composition remains largely unmapped. This study addresses this gap by developing and validating novel analytical method based on high-performance liquid chromatography with ultraviolet detection (LC–UV) for the determination of total content of GSH, Cys, Cys-Gly, and Hcy in berry fruits [4].

During the oral presentation, the results obtained at the stage of optimizing experimental conditions, including berry sample preparation, analysis, and validation of the newly developed analytical method, will be presented.

Keywords: aminothiols, berry fruits, high-performance liquid chromatography, superfruits.

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Effect of Marine Microalgae Lipid Extract on Skin Cells in *in vitro* Model of Healthy Cells, As Well As Psoriatic and Melanoma Cells. A Proteomic Insight

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Abstract

Marine microalgae are the rich sources of natural compounds with cytoprotective and antioxidant properties that may be ingredients of skin care products in cosmetology, as well as in preparations used to regenerate skin exposed to harmful environmental factors, including UV radiation (UVA and UVB) contained in sun light. Moreover, UVA/B radiation are often used in skin therapies/is often used in skin disease therapies, including irradiation of psoriatic lesions, in which both UVA and UVB radiation are employed. In addition to its therapeutic effects, UVA/B radiation also induces overproduction of free radicals and proinflammatory signalling in skin cells. On the other hand, chronic exposure to UV radiation may lead to cell mutations and the development of cancers, including one of the most metastatic and lethal cancers, melanoma. According to above, among the positive effects of natural extracts, potential effects on slowing down growth and proliferation, and even inducing apoptosis in skin cells with impaired signalling to divide or without checkpoints in the cell cycle, are also being explored. All these processes are executed by proteins (mainly enzymatic, receptors and transcription factors), but their activity is directly influenced by lipid-derived signalling molecules, including reactive aldehydes, prostaglandins, endocannabinoids and eicosanoids. Therefore, this study aimed to evaluate the impact of a lipid extract derived from the widely spread marine microalgae *Nannochloropsis oceanica* on the proteomic profile of various skin cells (keratinocytes, melanocytes, melanoma cells and psoriatic keratinocytes) following their exposure to UVA/B radiation.

As a results of proteomic analysis a number of proteins are found whose expression is changed in healthy cells exposed to UVA/B radiation, while the use of algae extract largely restores the levels of these proteins to those close to the control. The action of the extract has significantly different results in the case of cells with disturbed metabolism (psoriatic and melanoma cells), where it affects different groups of proteins differently, both in unexposed cells and in those exposed to UVA/B. Furthermore, the microalgae extract reduces the levels of lipid metabolism products (4-HNE/15d-PGJ2)-protein adducts in healthy cells exposed to UVA/B radiation, its effects depend on the function of the modified protein. The antioxidant/anti-inflammatory attributes of the lipid extract from *Nannochloropsis oceanica* suggest its potential as a protective agent for healthy skin cells against UVA/B radiation effects. Moreover, it could offer therapeutic benefits to skin cells from psoriatic lesions or melanoma cells by mitigating their proliferation and inflammatory responses.

Keywords: skin cells, melanoma, psoriasis, UV radiation, marine microalgae, lipid extract, lipid metabolism products, protein adducts.

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Prediction of Brain Stroke Using Machine Learning Algorithms

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Abstract

Stroke is a critical, life-threatening medical condition characterized by the interruption of blood supply to the brain, leading to potentially severe neurological damage. This thesis explores the prediction of stroke incidents using various machine learning algorithms, focusing on two primary types: ischaemic strokes, caused by blood clots and accounting for 85% of cases, and haemorrhagic strokes, resulting from ruptured blood vessels. Additionally, we consider transient ischaemic attacks (TIAs), or "mini strokes," which represent temporary disruptions in blood flow to the brain. The primary risk factor for stroke is high blood pressure, with other contributing factors including high cholesterol, tobacco use, obesity, diabetes mellitus, prior TIAs, end-stage kidney disease, and atrial fibrillation. Our study utilizes a dataset sourced from Kaggle, published in July 2022 by Jillani Soft Teck, which includes data from 4,982 patients. Each patient record comprises various parameters: gender, age, hypertension status, heart disease status, marital status, work type, residence type, average glucose level, body mass index (BMI), and smoking status. To predict stroke occurrences, we employ several machine learning techniques: logistic regression, deciding on trees, random forests, and support vector machines (SVM). We systematically evaluate and compare the performance of these models to identify the most effective approach for stroke prediction. The best artificial model when using Logistic Regression with accuracy 94.78% followed by SVM model. Our findings aim to contribute to the early identification and intervention strategies for individuals at risk of stroke, ultimately enhancing patient outcomes and reducing the burden of this debilitating condition.

Keywords: stroke prediction, machine learning, logistic regression, support vector machine (SVM), random forest, decision tree, ischaemic stroke, haemorrhagic stroke.

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Combined Effects of Cannabigerol and 3-O-ethyl Ascorbic Acid on Oxidative Stress in UVB-irradiated Keratinocytes

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Abstract

UVB radiation poses a significant threat to the skin by inducing DNA damage, oxidative stress, and disruption of keratinocyte function, contributing to photoaging and increasing the risk of skin cancer. Consequently, there is growing interest in natural compounds with antioxidant and anti-inflammatory properties, such as polyphenols and phytocannabinoids, as well as their combined use to enhance protective effects against UVB-induced damage. In this study, we investigated the effects of cannabigerol (CBG) and 3-O-ethyl ascorbic acid (EAA), a stable vitamin C derivative, applied individually or in combination to UVB-exposed keratinocytes. Both compounds showed complementary intracellular localization, being present in membrane structures and the cytosol. Notably, their combined application effectively counteracted UVB-induced changes in membrane properties, including increased fluidity and permeability, which was associated with improved cell viability and enhanced expression of membrane transport proteins. Co-treatment with CBG and EAA also supported redox homeostasis by reducing intracellular ROS levels and modulating key regulators of the Nrf2 pathway. Expression of Nrf2 activators (p62, MAPK) was increased, while inhibitors (Keap1, Bach1, PGAM5) were decreased, leading to enhanced activity of antioxidant enzymes (SOD1/2, CAT) and improved glutathione- and thioredoxin-dependent defense systems. As a result, oxidative damage to lipids and proteins was significantly reduced, as indicated by lower levels of 4-HNE, isoprostanes, protein adducts, and carbonyl groups. Additionally, both compounds exhibited anti-inflammatory effects by modulating NF-κB signaling through changes in regulatory components such as p62, IKKα, and IKKβ. Overall, these findings demonstrate that the combined use of CBG and EAA preserves membrane integrity, enhances antioxidant defenses, and reduces inflammation in UVB-exposed keratinocytes, highlighting their potential for further therapeutic development.

Keywords: keratinocytes, cannabigerol (CBG), 3-O-ethyl ascorbic acid (EAA), UVB radiation, redox balance, inflammation, lipid peroxidation.

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Comparison of Fatty Acid Composition in Animal-Derived Fats, Assess their Compliance with Dietary Recommendations

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Abstract

Animal-derived dietary fats—such as beef tallow, pork lard, poultry fat, and fish oil—are important components of a balanced diet and contribute to food texture and flavor [1,2]. Therefore, evaluating the fatty acid composition of animal-derived fats is important to assess their nutritional value and compliance with dietary recommendations. This study compares the fatty acid composition and physiological properties of fats from animal-derived food raw materials. Meat, fat, and fish samples from retail store X and selected farms were analyzed by lipid extraction, fatty acid profiling via gas chromatography, total omega-3 and omega-6 content calculation, and statistical analysis using a paired t-test in Microsoft Excel 2010. Saturated fatty acids predominated in chicken and ostrich fats, while monounsaturated fatty acids were highest in goose fat. Trans fatty acids were generally low, with the highest levels in beef fat. Polyunsaturated fatty acids, particularly omega-3 and omega-6, were concentrated in goose and salmon fats, supporting cardiovascular health. Poultry fats showed elevated omega-6 to omega-3 ratios, especially chicken (27:1), whereas beef fat had a favorable ratio (3:1) consistent with WHO guidelines. Differences in fatty acid profiles were linked to animal diet and seasonal feeding, affecting essential fatty acid distribution. Saturated fatty acids were highest in chicken and lamb fats; monounsaturated and polyunsaturated fatty acids were most abundant in goose, beef, and certain fish fats, with trans fats generally low and not harmful. Omega-6 to omega-3 ratios exceeded WHO recommendations in poultry but were balanced in beef and fish fats. Physiological effects depended on fatty acid chain length and structure, with some saturated and trans isomers linked to cardiovascular risk, while short-chain saturated fatty acids may offer protective or antimicrobial effects.

Keywords: Animal fats, fatty acid composition, omega-3 fatty acids, nutritional value.

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Assessment of Heavy Metal–Related Ecological Risks of Biochar Produced from Various Biowastes at Different Pyrolysis Temperatures

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Abstract

Biochar is a carbon rich material which can improve soil health, especially in degraded soils affected by erosion, contamination or nutrient loss, and producing it from various biological wastes promotes sustainable waste management [1]. However, feedstock type and production conditions affect physicochemical characteristics of biochar as well as concentrations of pollutants such as heavy metals [2-4]. Heavy metals pollution is attributed to human activities such as mining, industrial activity as well as the use of chemical fertilizers, pesticides and other products in agriculture [5-6]. Heavy metals can be toxic to humans as well as other living organisms [7] so it is important to analyse differing concentrations of these elements and assess the potential ecological risk of biochar before applying it to soil.

Heavy metals (Cr, Cu, Ni, Pb and Zn) were analysed in biochar produced from 6 different feedstocks (hemp leaves, stems, seed husks, sewage sludge, sawdust, and pig manure digestate) at five different temperatures (400–800 °C). Analysis showed that the highest concentrations of heavy metals were detected in biochar produced from sewage sludge, which was associated with moderate risk, and pig manure digestate, which may fall into either moderate or low risk category.

Keywords: biochar, heavy metals, ecological risk.

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The Simplified Method for the Determination of Toxic Alkaloids from Various Parts of *Datura* L. by Use of Chromatographic and Spectroscopic Techniques

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Abstract

Plants of *Datura* L. genus especially their biological and pharmacological significance, toxicological properties, and the application of tropane alkaloids such as scopolamine, atropine, and hyoscyamine were discussed. Species such as *Datura stramonium*, *Datura metel*, and *Datura innoxia* among other things are differ in leaves height ang shape, colour of flowers, and fruit appearance. Despite their potential medicinal benefits, uncontrolled use of these plants is associated with the risk of neurological toxicity and serious side effects, such as hallucinations and, even death in extreme cases. The classification of plant alkaloids as well as methods of their extraction and analysis, including chromatographic techniques (TLC) and spectroscopic methods (UV-Vis, FT-IR, NMR), were also presented.

The aim of the experimental part was to investigate extracts obtained from selected morphological parts of *Datura* L. plants regarding the content of tropane alkaloids and antioxidant activity. In the first stage, methanolic extracts were prepared from leaves, flowers, stems, seeds, seed husks, and roots by maceration. Subsequently, preliminary detection of alkaloids was performed using a reaction with Dragendorff's reagent. A qualitative analysis was also carried out by thin-layer chromatography (TLC). To assess antioxidant properties, the DPPH radical test was applied, and the content of phenolic compounds was determined using the Folin-Ciocalteu reagent and UV-Vis spectrophotometry. Finally, FT-IR spectral analysis was conducted to confirm the presence of scopolamine in studied extracts.

We found that extracts from flowers, husks, and leaves of both studied species exhibit the highest antioxidant potential and alkaloid content. Roots of *Datura stramonium* are rich of polyphenols, although they have lower antioxidant activity. Extracts from *Datura metel* like flowers, leaves and stems characterised higher total phenolic content compared to *Datura stramonium*. FT-IR spectroscopy is effective in the identification of scopolamine at relatively high concentrations. The proposed method applied for the isolation and determination of biologically active compounds from *Datura* L. plants can be successfully use in forensic science.

Keywords: *Datura* L., extraction, chromatography, infrared spectroscopy, tropane alkaloids.

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Temporal Shifts in the Plasma Lipidome During the Subacute Phase of Recovery Following Myocardial Infarction

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Abstract

Acute myocardial infarction (MI) triggers a cascade of systemic metabolic disturbances. While the immediate acute phase and long-term chronic outcomes are well-documented, the biochemical landscape of the early recovery period (3–6 weeks post-MI) remains an underexplored transitional window. This study aimed to characterize the dynamics of lipid remodeling during this critical stage of cardiac healing.

Using an LC-MS-based lipidomic approach, we performed a comparative analysis of plasma lipid profiles—focusing on phospholipids, sphingomyelins (SMs), and ceramides (Cers)—among three groups: patients during acute MI, patients in the early recovery phase (3–6 weeks), and healthy controls. Our findings reveal distinct lipidomic signatures across the recovery continuum. Acute MI was characterized by a significant depletion of polyunsaturated phosphatidylcholines (PCs) and plasmalogens. By the 3–6 week mark, we observed a divergent recovery pattern: PC-derived plasmalogens showed partial restoration, whereas PE-derived plasmalogens remained persistently suppressed. Interestingly, while lysophospholipids normalized alongside declining inflammatory markers, ceramide levels remained elevated in the recovery group. Pathway analysis confirmed that although acute MI severely disrupts glycerophospholipid and arachidonic acid metabolism, these pathways only achieve partial normalization during early recovery.

These results demonstrate that the plasma lipidome undergoes complex, species-specific remodeling during the first weeks after an infarct. The persistence of certain lipid alterations (e.g., elevated ceramides) suggests that metabolic recovery lags behind clinical stabilization. Our study highlights the potential of lipidomics to monitor the metabolic state of patients during the subacute phase of MI, offering new insights into post-infarction management.

Keywords: acute myocardial infarction, plasma, phospholipids, lipidomics.

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Calcium-Driven Enhancement of Calcein Release in Electroporated Wild-Type and ANXA4-Knockout MCF7 Cells

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Abstract

Electroporation permits molecules to pass through the cell barrier within controlled conditions by temporarily breaking the plasma membrane. The possibility for releasing intracellular molecules remain less examined, compared to molecule electrotransfer. This work focuses on the impact of extracellular calcium and the membranes repair protein Annexin A4 (ANXA4) on the release of calcein from MCF7 breast cancer cells treated with high-voltage pulses.

Plasma membrane impermeant Calcein-AM was accumulated in wild-type and ANXA4 knockout (KO) MCF7 cells, which were subsequently electroporated using electric fields ranging from 0.8 to 1.6 kV/cm in buffers containing either 0 mM or 2 mM $CaCl_2$. Calcein release was analysed using flow cytometry.

Results demonstrated that at higher field strengths, calcium greatly enhanced the release of calcein. The stabilizing function of Annexin A4 under membrane stress was shown by the observation ANXA4-KO cells released more calcein than wild-type cells. Extraction was further improved using a double pulse procedure, particularly in calcium-rich environments. The results show that whereas ANXA4 inhibits membrane leakage, calcium significantly improves electroporation-mediated extraction.

Keywords: electroporation, calcium ions, calcein release, MCF7 cells, annexin A4, membrane repair.

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Differences in the Meconium Microbiome Profile in Very Low-Birth Weight Preterm Newborns and Full-term Newborns

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Abstract

The importance of the microbiome and its impact on human health have become increasingly evident, particularly in early life. In newborns the microbiome plays a crucial role in nutrient absorption, metabolic regulation, and immune system development, thereby influencing long-term health and growth[1]. Factors related to pregnancy and delivery have been proposed to contribute to the initial microbial colonization of the neonatal gut, laying out a foundation for its development[2]. The meconium microbiome profile reflects this early microbial seeding. Preterm infants, who are often of low birth weight, are especially vulnerable to health issues. This study aims to investigate the difference in the meconium microbiome profile in preterm and full-term born neonates, additionally looking for alterations associated with clinical factors, like the mode of delivery and antibiotic administration during delivery, and their effects in the two groups.

A total of 184 meconium samples were included in the study, with 96 stool samples being taken from normal-weight full-term and 88 from very low-weight preterm born neonates. Genomic DNA was extracted from stool samples, and the bacterial V3–V4 hypervariable region of the 16S rRNA gene was amplified and sequenced on the Illumina MiSeq platform. The data were processed using bioinformatic tools and analysed bioinformatically and statistically to assess microbiome composition, abundances, alpha- and beta-diversities.

The analysis revealed significant differences in the bacterial profiles found in the meconium of very low-weight preterm and full-term newborns. Preterm infants exhibited higher richness but lower evenness, indicating a greater presence of low-abundance taxa alongside increased dominance of specific bacteria. At the genus level, *Staphylococcus* was most abundant in preterm samples, whereas *Escherichia-Shigella* predominated in full-term neonates. The compositional difference was statistically significant. We observed that clinical factors, like the mode of delivery and maternal antibiotic use, influence the meconium microbiome, with partially differing effects between preterm and full-term groups.

In conclusion, the meconium microbiome of preterm, low-birth-weight infants differs significantly from that of full-term neonates, both in composition and distribution. Preterm infants show a microbiome characterized by increased dominance and a higher prevalence of potentially pathogenic taxa. The immaturity of the preterm neonates seems to impact the initial microbial colonization of the gut microbiome, possibly playing together with different and often more severe clinical and health conditions preterm infants are in and exposed to. Comparing the microbiome dynamics in neonates of different gestational ages over time could provide valuable insights into the development of the microbiome and its impact onto neonatal diseases.

Keywords: microbiome, newborn, preterm, full-term, meconium.

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Polyploidy-Driven Modulation of Drought Stress Responses in *Hemerocallis* L.: Insights from Integrated Molecular and Physiological Analyses

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Abstract

Polyploidization is a fundamental mechanism that influences plant adaptation and is increasingly relevant to the development of stress-resilient crops. However, its functional role in ornamental species remains insufficiently characterized. Using *Hemerocallis* L. (daylily) as a model system, this study investigates how genome duplication modulates drought-stress responses through an integrated analysis that combines genetic, physiological, and transcriptomic approaches.

A global overview of species distribution and cultivar origin revealed distinct patterns associated with ploidy level, indicating historical selection linked to environmental performance. Comparative analyses of diploid and tetraploid cultivars were performed using SSR-based genotyping together with morphological and physiological characterization under controlled drought conditions. Reduced genetic diversity observed in modern cultivars is consistent with a domestication bottleneck.

Tetraploid genotypes exhibited enhanced drought tolerance, reflected in improved water retention capacity, more efficient stomatal regulation, and sustained photosynthetic activity under stress. RNA-seq-based transcriptomic analysis further demonstrated ploidy-dependent gene expression patterns, including evidence of a gene-dosage effect in the cultivar 'Trahlyta'. This response involved broader activation of stress-responsive pathways, transcription factors, and hormone- and MAPK-mediated signalling networks.

These findings demonstrate that genome dosage plays an important role in regulating complex stress-response mechanisms and highlight the value of integrating multi-level datasets to elucidate adaptive traits. The results provide a framework for applying polyploidy to the development of drought-resilient ornamental crops and advance climate-adaptive breeding strategies in *Hemerocallis* and related species.

Keywords: polyploidy, drought stress, *Hemerocallis*, transcriptomics, gene dosage, ornamental breeding, climate adaptation.

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Rethinking Nile Red: Can Sustainable Fluorescent Dyes Enable Greener Microplastic Detection?

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Abstract

Microplastic pollution has become a major environmental concern, however its reliable detection remains a key challenge for environmental monitoring [1]. Among available analytical approaches, fluorescence-based staining has become one of the most widely applied techniques due to its relative simplicity, sensitivity, and ability to rapidly screen large numbers of particles. This method relies on the affinity of hydrophobic fluorescent dyes for polymer surfaces, enabling visualization of microplastics under fluorescence microscopy [2].

Nile Red is commonly used for this purpose due to its strong fluorescence and broad compatibility with different polymer types. However, its environmental impact, potential toxicity, and solvent requirements raise concerns within the context of sustainable analytical chemistry. As a result, there is increasing interest in identifying alternative fluorescent dyes that would maintain analytical performance while reducing their environmental impact [2],[3].

In this study, three alternative dyes: Coumarin 6, Coumarin 153, and Curcumin, were evaluated as possible alternatives for Nile Red in microplastic detection. Three dye concentrations (10, 15, and 50 µg/mL) were tested for each dye. Staining was performed using ultrasonic treatment for 45 minutes. Six polymer types (LDPE, HDPE, PP, PA, PET, and PS) were stained individually and examined using a NIKON Eclipse Ni-U fluorescence microscope. The acquired images were analyzed with ImageJ software to assess fluorescence intensity and staining uniformity. In addition, a selected dye concentration was used to evaluate staining performance on mechanically and thermally degraded polymers.

The results indicate that Nile Red consistently produces the highest fluorescence intensity. Among the tested alternatives, Coumarin 6 showed the most promising performance, demonstrating the ability to stain multiple polymer types, although with lower fluorescence intensity. Increasing dye concentration did not significantly improve staining outcomes. Furthermore, mechanically and thermally degraded polymers exhibited more uniform and enhanced staining, suggesting that polymer surface properties play a critical role in dye interaction and fluorescence response.

Although none of the tested dyes fully matched the performance of Nile Red, Coumarin 6 represents a potential environmentally friendlier alternative. These results show that improving sustainability may come at the cost of sensitivity, and that both dye choice and polymer condition play an important role in microplastic analysis.

Keywords: microplastic, fluorescence, NileRed, coumarin-6, coumarin-153, curcumine.

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Nettle (*Utrica dioica* L.) Slurry as a Plant Biostimulant: Interactions with Mineral Nitrogen and Effects on Growth Traits and Soil Dehydrogenase Activity in Spring Wheat

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Abstract

The integration of organic biostimulants with mineral nitrogen (N) fertilizers represents a promising approach to improve soil biological activity and crop growth while reducing reliance on synthetic inputs. This study evaluated the individual and combined effects of nettle (*Utrica dioica* L.) slurry and synthetic mineral N fertilizer on soil enzymatic activity and growth performance of spring wheat under controlled conditions. A pot experiment was conducted in a growth chamber using an unfertilized control (water), mineral N at 45 and 75 kg ha^{-1}, nettle slurry 5%, 10% and 20% concentrations, and their combinations. Plant growth parameters (root length, shoot length, dry weight) and soil dehydrogenase activity were determined. Nettle slurry applied alone with 20% concentration improved plant growth and soil enzymatic activity. Combined applications further enhanced these responses, indicating synergistic interactions between organic and mineral N sources. The nettle slurry 20% + 75 kg ha^{-1} N treatment produced the greatest increases in root length, shoot length, root and shoot dry weight, and soil dehydrogenase activity by 26%, 47.4%, 1.85%, 3.39 % and 12% respectively. Overall, integrated fertilization with nettle slurry and mineral N markedly stimulated soil microbial activity and spring wheat growth compared with single-source fertilization. These findings highlight the potential of nettle-based organic amendments to enhance nutrient use efficiency and soil biological activity in cereal production systems.

Keywords: stinging nettle, slurry, biostimulant, nitrogen fertilization, dehydrogenase, sustainable agriculture.

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Development of Protein-Enriched Crackers Incorporating Milk Protein Concentrate and Fermented Oat Milk By-Products

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Abstract

The growing demand for functional and protein-enriched snack products has encouraged the development of sustainable formulations utilizing nutrient-dense by-products. This study presents an extended investigation into the formulation of protein-enriched crackers incorporating milk protein concentrate (MPC) and fermented oat milk by-products, with comprehensive physicochemical, textural, and sensory evaluation [1;2].

Composite flours containing oat milk residues and MPC were formulated using egg white or flaxseed gel as binding agents. Both fermented and non-fermented dough systems were developed. Dough and cracker samples were analyzed for moisture content, pH, total titratable acidity (TTA), color parameters (L*, a*, b*), and texture profile analysis. Sensory evaluation was conducted to assess overall acceptability, taste, texture, aroma, and appearance. Statistical analysis was performed to determine significant differences among formulations ($p < 0.05$).

The results demonstrated that fermentation and binder type significantly influenced physicochemical and textural properties. Fermented samples exhibited increased acidity and improved structural characteristics, contributing to enhanced shelf-life potential. Egg-based formulations showed significantly lower hardness values compared to flaxseed-based samples, indicating improved crispness and consumer acceptability. Statistical validation confirmed that protein enrichment did not negatively affect sensory attributes; instead, fermented formulations achieved the highest overall acceptance scores.

The findings confirm that milk protein concentrate and fermented oat milk by-products can be successfully valorized in the development of high-protein crackers with desirable technological and sensory qualities. These results provide stronger scientific evidence supporting sustainable functional snack innovation and the utilization of food industry by-products within sustainable food systems [3-5].

Keywords: protein-enriched crackers, milk protein concentrate, fermented oat by-products, functional foods.

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Intracellular Macromolecule Loss as a Key Determinant of Cell Fate Following Irreversible Electroporation in CHO-K1 Cells

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Abstract

High-voltage electric pulses used in electroporation transiently increase membrane permeability, initiating two mechanistically distinct pathways of cell death [1, 2]. The first, termed first-stage irreversible electroporation (FirEP), involves immediate and catastrophic membrane failure. The second, late-stage irreversible electroporation (LirEP), arises from delayed cellular stress responses following initial pore closure [1, 3]. To better understand the determinants of cell fate following electroporation, we examined intracellular molecule efflux and post-treatment viability in CHO-K1 cells using flow cytometry and clonogenic assays [1].Our results demonstrate that the trajectory of cellular recovery or death is established within 35 minutes of electroporation, after which no phenotypic reversal was observed [1, 3]. Rather than depletion of small molecules such as ATP, the loss of high-molecular-weight macromolecules (exceeding 30 kDa) including proteins and nucleic acids emerged as the predominant driver of cell death [1]. Critically, the addition of electroporation-conditioned supernatant to culture medium partially restored viability in LirEP-affected cells, highlighting the importance of retaining intracellular contents for cell survival [1].These findings advance our mechanistic understanding of electroporation and carry meaningful implications for both oncological applications and regenerative medicine [2], offering potential strategies to enhance the precision and efficacy of electroporation-based therapies.

Keywords: electroporation, cell viability, membrane permeabilization, intracellular molecule loss, cancer therapy, cell death mechanisms, pore resealing.

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Development and Modeling of Nutraceutical Compositions Based on Technologically Functionalized Pea Proteins and Spirulina (*Arthrospira platensis*)

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Abstract

The aim of this study was to develop nutraceutical compositions (NC) from technologically functionalized pea protein isolate (PPI) and spirulina (*Arthrospira platensis*). To improve the nutritional and sensory properties of PPI, the effect of ultrasound (US) was evaluated based on the following indicators: free amino acids (AA), fatty acids (FA), biogenic amines (BA), volatile compounds (VC), overall flavor (OFA), odor (OOA), texture (OTA), and sensory (OSA) acceptability, as well as the intensity of facial emotional expressions induced in consumers (VSE). Subsequently, the optimal functionalized PPI was utilized for composing NC. To increase the functionality of the NC, the recipes included spirulina, while *Zanthoxylum armatum* pepper was used to enhance OSA. The following quality indicators of the NC were analyzed: OFA, OOA, OTA, OSA, overall color acceptability (OCA), VSE, and color coordinates (CC). Results showed that US treatment significantly affected free lysine (FL) content in PPI ($p = 0.008$); 80 min of US resulted in a 12.5% increase in FL concentration compared to the control (P0). In both P0 and US-treated samples, the levels of BA and FA remained within the margin of error. The PPI treated with US for 60 min (P60) was the most acceptable, with 37% higher OTA ratings than other samples. P60 also induced a 60% higher intensity of the VSE "happy" and was selected for NC formulations. NC modeling revealed that pepper and spirulina had a significant effect on the OOA ($p = 0.009$) and CC ($p < 0.001$). The OOA of the S1Z1 sample (20 g base + 0.1 g pepper + 0.2 g spirulina) received the highest rating (4.2 points), while the highest OSA (3.1 points) was observed in the K and S1 samples (K – 20 g base; S1 – 20 g base + 0.2 g spirulina). Strong correlations were found between the VC of the NC and VSE: certain ketones correlated negatively with VSE "happy," while carboxylic acids and aldehydes correlated positively. A higher greenness (-a*) CC reduced the positive emotional response during NC tasting. In conclusion, the technological functionalization of PPI using US is an effective solution for increasing PPI acceptability while maintaining stable safety parameters. Both K and S1 exhibited an identical OSA of 3.1 points. The addition of spirulina (1%) had no negative impact on product acceptability parameters, and the NC base formula ensured an acceptable product texture (3.9 points).

Keywords: ultrasound, intensity of facial emotional expressions, volatile compounds, overall sensory acceptability, amino acids, biogenic amines.

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Controlled Environment Cultivation: An Appropriate Technique for Medicinal and Aromatic Plants Growing

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Abstract

One of the most efficient approach to meet the customer demand and cultivate superior-quality medicinal and aromatic plants is growing them in a controlled environment system. In daily life, medicinal and aromatic plants are beneficial to their vital and important roles. Growing them in conventional methods dose not fulfil the demand of customers. The aim of this research is to study the potential of growing some valuable and familiar medicinal and aromatic plants in controlled environment to enhance the bioactive phytochemical composition. In this study some well-known species of Lamiaceae family, including *Dracocephalum kotschyi*, *Dracocephalum maldavica*, *Salvia nemorosa*, *Salvia officinallis*, *Thymus daenensis*, *Thymus vulgaris*, *Thymus serpyllum*, *Provskia arbotonoides*, *Satureja hortensis, Provskia atriplicfolia*, *Zataria multiflora* and *Ziziphora tenuior* were chosen. After seed germination in rockwool substrate, seedlings were transferred to the deep water culture system and placed in a growing chamber (23/19 °C day/night temperature). A light-emitting diode setup providing 250 µmol/(m^2·s), consisting of 15% blue (455 nm), 15% white and 70% red (660 nm) light was used as the light source (16/8 h photoperiod). The finding revealed that all plant species exhibit normal and typical growth. Growing of some of them was more adapted and friendly with controlled condition. Analysis of antioxidant activity and chlorophyll content showed that a significant difference among plants species, so that antioxidant activity in *Thymus vulgaris, Thymus serpyllum, Thymus daenensis, Provskia arbotonoides* and *Dracocephalum maldavica* was higher than other species. Overall, it can be state that growing selected medicinal and aromatic plants in the controlled environment condition is an efficient and proper system and optimizing final biomass and phytochemicals in this growing system depends on plant species.

Keywords: plant biomass, secondary metabolites, soilless cultivation system.

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Phytochemical Profile of Strawberries: The Role of Phenols and Antioxidants in Determining Micromycete Prevalence Across Maturity Stages

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Abstract

Strawberries are widely valued for their nutritional properties and high content of bioactive compounds; however, they are also highly susceptible to microbial contamination during fruit ripening. This study aimed to evaluate the distribution of micromycetes and yeasts, as well as antioxidant activity and total phenolic content, in strawberries of two cultivars, *Aprica* and *Malvina*, at different ripening stages. Strawberry fruits were collected at three ripening stages (I – early, II – intermediate, III – fully ripe). Micromycetes were isolated using malt extract agar and identified based on morphological characteristics. Antioxidant activity was determined using DPPH, ABTS, and FRAP assays, while total phenolic content was measured using the Folin–Ciocalteu method. Three micromycete genera (*Mucor mucedo*, *Penicillium expansum*, *Rhizopus stolonifer*) and two yeast genera (*Rhodotorula* and *Candida*) were identified in the analysed samples. A greater diversity of micromycetes was observed in the *Aprica* cultivar, especially at the fully ripe stage, where yeasts more frequently colonized *Malvina* fruits. The antioxidant activity increased with fruit ripening in both cultivars. The highest DPPH and ABTS radical scavenging activity was detected in fully ripe *Malvina* fruits (109.02 and 133.88 μmol TE/g, respectively). The total phenolic content also increased during ripening, reaching 25.64 mg GAE/g in *Aprica* and 25.60 mg GAE/g in *Malvina* fruits. These results demonstrate that strawberry cultivar and ripening stage significantly influence micromycete occurrence and antioxidant properties of the fruits

Keywords: strawberries, micromycetes, antioxidant activity, phenolic compounds, ripening stage, cultivar.

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The Imbalance of Selected Ions Concentration as a Mediator of Cell Death

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Abstract

The human body needs the basic nutrients: proteins, fats and sugars for proper development, but it also needs vitamins and elements. Elements can be divided into macro- and microelements. Macronutrients are present in tissues at high levels. To this group belongs Na, K, Ca, P, Mg, and S. Microelements are present in tissues in trace or irregular concentration. To this group belongs Mn, Mo, Ni, Co, Cu, Fe, Zn, I, and Se. However, they play a very important role in cell metabolism. Chromium, iron, molybdenum, nickel and cobalt are trace elements, whose balance is essential for proper cell functions.

HepG2, L_{929} and Caco-2 cell lines were exposed to known concentrations of chromium chloride, iron chloride, nickel chloride, molybdenum trioxide and cobalt chloride (200 or 1000 □M used alone and in combinations). Concentrations of chromium, iron, nickel, molybdenum and cobalt in the cell lysate and the culture medium were determined by ICP-MS. Moreover, sodium, potassium, calcium and magnesium concentrations were also measured. What is more, cells were observed under light and scanning electron microscope.

In all three types of untreated cells, the iron level was detectable. The highest concentration was observed in fibroblasts. Chromium, molybdenum and cobalt were detectable only in Caco-2 cells. Whereas nickel was undetectable in all used cell lines. In cells treated with chromium, iron, molybdenum, nickel and cobalt used alone, in all cell lines, the dose-related increase of microelements concentration inside the cells was observed. The dose-dependent increase in the concentration of chromium, iron, nickel, molybdenum and cobalt in all cell lines after incubation with elements was observed.

Sodium concentration in all used cell lines incubated with chromium, iron, molybdenum, nickel and cobalt used alone increases when compared with control cells.

Magnesium and calcium concentrations increase in cells incubated with chromium, iron, molybdenum, nickel and cobalt used alone when compared with control cells. Moreover, magnesium and calcium concentrations increase in cells incubated with mentioned above microelements used in all combinations when compared with control cells and cells incubated with microelements used alone.

All studied types of cells were observed under an inverted light microscope and scanning electron microscopy (SEM). Control cells showed normal morphology. The SEM images show that the absorptive surface of Caco-2 cells is covered with densely packed microvilli, indicating the formation of a well-differentiated brush border structure. The L_{929} cells were well-spread and flattened, and they overlapped each other, covering the coverslip. The HepG2 cells were also well-spread, covering the coverslip.

Incubation of cells with microelements used alone and in combinations induces cell morphology changes. In cells incubated with microelements, the following changes were observed: decreased number of cells, cells rounded up with loosened cell junctions, cells with gap junctions shrank and showed decreased surface microvilli, cells showed a round apoptotic-like morphology

The mechanism leading to apoptosis depends on mitochondrial and RE disruption. What is more, the presented study shows the crucial role of these elements in the induction of cell death as a result of an imbalance of sodium, potassium, calcium and magnesium concentration inside the cell.

Keywords: chromium, iron, nickel, molybdenum, cobalt, sodium, potassium, calcium and magnesium, cell death.

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Changes in Extractable Anthocyanin Content Stability in Anthocyanin-rich Winter Wheat (*Triticum aestivum* L.) Breeding Lines

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Abstract

Anthocyanins are bioactive flavonoid pigments widely studied due to their antioxidant properties; however, their stability is affected by environmental factors such as temperature, oxygen exposure, pH, and light. Spectrophotometric methods are frequently used for the determination of anthocyanins in plant extracts because they are rapid and cost-effective compared with chromatographic techniques. However, measurements may be influenced by sample extract turbidity, suspended particles, and extraction efficiency, which can affect absorbance values and thus the apparent pigment content. Sample extract handling procedures, including freezing and thawing, may therefore influence spectrophotometrically determined anthocyanin levels. The aim of this study was to evaluate the effect of freezing and short-term post-thaw extract storage on total anthocyanin content (TAC) in winter wheat (*Triticum aestivum* L.) breeding material. Seventy winter wheat genotypes were analyzed. TAC was determined spectrophotometrically at approximately 520 nm after extraction with acidified methanol and expressed as mg/kg dry matter (DM). Measurements were performed at three stages: before freezing (T0), after frozen storage and thawing (T1), and 24 h after thawing (T2). Mean TAC increased from 47.65 ± 3.60 mg/kg DM at T0 to 54.22 ± 3.65 mg/kg DM at T1, corresponding to an increase of approximately 14%. After 24 h post-thaw (T2), TAC values slightly decreased to 52.23 ± 3.73 mg/kg DM (in average) but remained higher than the initial values. A linear mixed model with genotype included as a random effect revealed a significant effect of measurement stage ($\chi^2 = 387.48$, df = 2, $p < 0.001$). Post-hoc pairwise comparisons with Holm correction confirmed significant differences between all stages. The increase in measurable TAC after freezing likely reflects structural changes in plant tissues that enhance pigment extractability, whereas the slight decline after thawing may be related to partial anthocyanin degradation during short-term storage. These results indicate that extract freezing can systematically influence spectrophotometrically measured anthocyanin values. Therefore, careful control of sample handling and consistent timing of post-thaw measurements are important when comparing anthocyanin levels in cereal extracts and evaluating anthocyanin-rich wheat material.

Keywords: anthocyanins, spectrophotometry, UV-Vis analysis, winter wheat.

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The Role of Bioinformatics in Determining the Genes Responsible for Certain Hereditary Dental Diseases

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Abstract

The role of bioinformatics in identifying genes responsible for hereditary dental diseases is increasingly significant. As genetic variations can influence the development and integrity of various dental tissues, bioinformatics provides an essential framework for analyzing and interpreting the molecular data underlying these conditions. This study reviews a range of hereditary dental disorders and highlights key genetic associations reported in the literature, offering a broader context for understanding their molecular basis. Data for this research were obtained from the Bioinformatics for Dentistry database, which compiles genomic, proteomic, and structural information related to dental tissues. The ENAM gene was selected for detailed analysis due to its relevance in dental development. Using BLAST (blastx), the ENAM nucleotide sequence was compared with protein databases to identify homologous proteins and assess functional similarities. Multiple sequence alignment was then performed using Clustal Omega to compare enamelin protein sequences across several species, enabling the identification of conserved regions and evolutionary relationships. Although no specific pathogenic mutations were detected, the analyses provided valuable insights into the genetic features of the ENAM gene and its relevance to hereditary dental conditions. The findings highlight the importance of bioinformatics in studying genetic contributions to dental diseases and demonstrate how sequence-based analysis can support future efforts to improve diagnostic and therapeutic approaches in dental genetics.

Keywords: bioinformatics, hereditary dental diseases, genetic associations, ENAM gene, BLAST, Clustal Omega, enamelin, sequence alignment.

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Control of the IVF Embryo Microenvironment: Temperature, pH, Gas Conditions, and Time-Lapse Monitoring as a Scientific Challenge

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Abstract

Successful human embryo culture *in vitro* depends on maintaining a stable microenvironment outside the reproductive tract. During IVF, embryos are exposed to artificial culture conditions, where small fluctuations in temperature, pH, gas composition, osmolality, light exposure, or handling frequency may influence embryo physiology, developmental kinetics, and viability. Current IVF laboratory recommendations emphasise that oocytes and embryos should be maintained under appropriate temperature, pH, and osmolality conditions, while exposure to light, toxic substances, and harmful radiation should be minimised [1]. Bicarbonate-buffered media also depend on controlled CO_2 conditions, demonstrating the close relationship between gas environment and culture-medium pH stability. This presentation discusses the scientific importance of microenvironmental control in embryo culture, focusing on temperature regulation, CO_2-dependent pH stability, oxygen concentration, and the reduction of environmental stress during embryo assessment. Time-lapse monitoring is presented as a technological approach that enables continuous observation of embryo development while reducing the need to remove embryos from controlled incubator conditions. ESHRE good-practice recommendations describe time-lapse technology as a method in which embryo images are recorded at regular intervals, allowing dynamic assessment without removing embryos from the incubator [2]. Beyond image acquisition, time-lapse systems generate morphokinetic data that may support more standardised embryo assessment and provide insight into developmental dynamics. However, morphokinetic interpretation should be approached critically, as embryo developmental timing can be influenced by culture conditions, including temperature, pH, culture media, and oxygen concentration [3]. Therefore, time-lapse monitoring should be considered not only as a tool for embryo selection, but also as a research and quality-control approach for understanding how laboratory conditions affect embryo development.

Keywords: IVF, embryo culture, microenvironmental control, time-lapse monitoring, embryo assessment, laboratory standardization.

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SPECIAL SESSION ON CLIMATE CHANGE AND SUSTAINABLE CONSTRUCTION

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Energy Efficiency and Heritage Preservation on Serbia's Valuable Built Environment

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Abstract

Serbia's valuable built environment, including historical and cultural heritage buildings older than 50 years, represents an important cultural and social asset, but also a challenge for energy efficiency and climate change mitigation. Buildings in this category are characterized by high energy consumption, typically exceeding 140-200 kWh/m²·year, and are mostly classified within energy classes F-G. Results indicate that Serbia has a relatively comprehensive legislative framework that allows the integration of energy efficiency measures, renewable energy systems, and circular economy principles in heritage buildings. However, implementation remains limited due to weak coordination between heritage protection and energy regulations, lack of harmonized technical guidelines, and insufficient institutional capacity. Stakeholder analysis highlights financial constraints as the most critical barrier. Public funding for cultural heritage remains below 1% of the national budget, which significantly limits large-scale refurbishment activities. In addition, administrative complexity, lack of incentives, and limited technical expertise further slowdown the adoption of sustainable solutions. Despite these challenges, case-based evidence shows that targeted interventions can improve building performance from energy classes F-G to D or C without compromising cultural integrity. The findings emphasize the need for integrated policy frameworks, dedicated financial instruments, and capacity-building programs to support climate-resilient and energy-efficient transformation of heritage buildings. The paper contributes to bridging the gap between conservation and sustainability and supports Serbia's alignment with European climate and energy goals.

Keywords: valuable built environment, energy efficiency, cultural heritage buildings, sustainable refurbishment, climate change.

Acknowledgments: This research was conducted within the project "EU-REPAIR – Toolkit for sustainable optimisation of valuable built environment", supported by the European Climate Initiative (EUKI).

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Frameworks and Challenges: Insights from the EU-REPAIR Estonian National Study

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Abstract

This presentation introduces the results of a national study conducted within the EU-REPAIR project. The study aimed to provide an overview of the framework surrounding the conservation and renovation of valuable built environments (buildings older than 50 years). Attention was given to legislation, institutional structures, funding mechanisms, education and learning materials. The analysis of these aspects revealed key challenges and opportunities for improvement.

A significant part of the research also included a stakeholder survey, whose qualitative results added important depth to the understanding of conservation and renovation processes of valuable built heritage. This type of analysis enables comparison with results from other project partner countries, helping to identify both shared challenges and country-specific differences, also creating opportunities for mutual learning.

The findings indicate that while the conservation and renovation of valuable built environment is an important topic in Estonia, there is still room for improvement, particularly in the areas of funding schemes, guidelines and broader heritage awareness.

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Sustainable Repair and Refurbishment in VBE in North Macedonia (EU-REPAIR Project)

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Abstract

The EU-REPAIR project "Toolkit for Sustainable Optimization of Valuable Built Environment" aims to promote sustainable refurbishment of heritage and valuable buildings across Estonia, Germany, Lithuania, North Macedonia, and Serbia, contributing to reduced carbon emissions and strengthened climate resilience. The project focuses on the preservation and adaptive reuse of the valuable built environment (VBE), integrating sustainability principles such as energy efficiency, circular economy, renewable energy integration, and climate risk into refurbishment practices. Within the project framework, comprehensive research was conducted across several thematic areas, including risk assessment, building refurbishment and repair strategies, energy improvement, renewable energy, and circular economy principles, all in relation to VBE. These findings were compared with existing national knowledge, policies, and technical guidelines in each of the five countries.

The growing need to reduce carbon emissions and improve climate resilience in the built environment reveals significant challenges in the sustainable refurbishment of VBE across Europe. In North Macedonia, these challenges are particularly evident due to an energy-inefficient building stock, limited application of circular economy principles, and insufficient integration of climate risk assessment in conservation and refurbishment practices. Existing national frameworks and guidelines only partially address these issues, resulting in fragmented and inconsistent approaches to sustainable renovation.

This abstract presents the national research conducted in North Macedonia. The study focuses on the specific characteristics of the country's VBE, the current state of conservation and refurbishment practices, and the integration of sustainability principles in existing strategies. Particular attention is given to identifying challenges related to energy inefficiency, limited application of circular approaches, and the need for improved risk assessment methodologies in the context of heritage and valuable buildings.

The methodology was based on a structured questionnaire survey, with 120 responses collected from stakeholders involved in the VBE. The questionnaire examined stakeholder roles, awareness of policy and legal frameworks, and practical challenges in sustainable refurbishment. It also addressed the application of sustainability measures, including energy efficiency, renewable energy, circular economy, risk assessment, and climate change mitigation. Additional sections explored public perception, community engagement, and future needs. This approach provided comprehensive insights into current practices, gaps, and opportunities for improvement.

The results reveal a key gap in the legal framework for the VBE, mainly due to the lack of harmonization between engineering and heritage standards, unclear institutional responsibilities, and weak integration of heritage and environmental policies. Future work should focus on policy alignment, institutional coordination, capacity building, and improved financial and awareness-raising mechanisms.

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Sustainable Refurbishment of Valuable Built Environment in Germany: Gaps, Barriers, and Lessons for Practice

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Abstract

This paper presents the German national study developed within the EU-REPAIR project and examines how valuable built environment (VBE) is addressed in law, policy, and practice in Germany. In this study, VBE includes listed heritage and older buildings with architectural, cultural, or social value that may not be formally protected but are still considered worthy of preservation. The paper focuses on the central tension between climate goals, fabric preservation, and practical implementation in existing buildings.

Methodologically, the study combines a structured review of legal, regulatory, technical, and funding frameworks with stakeholder survey data and selected case studies. The analysis is designed as a scoping study rather than a statistically representative national assessment. It aims to identify decision constraints, implementation bottlenecks, and transferable lessons for sustainable repair and refurbishment.

The results show that Germany has a comparatively strong but fragmented framework for heritage protection and energy-related refurbishment. However, major gaps remain in the integration of monument protection with environmental goals, in the operationalization of repair-first approaches, and in support for circular economy, risk assessment, and climate adaptation. Survey findings indicate that the most significant barriers are high costs, complex approval procedures, difficult communication with authorities, and limited digitalization. Among the respondents, 20 of 23 identified the missing link between heritage protection and environmental goals as the most important gap in the current framework. Knowledge and perceived regulatory support were strong for refurbishment and energy efficiency, but clearly weaker for circular economy and risk assessment.

The paper argues that sustainable refurbishment of VBE requires more than energy upgrading. It requires integrated governance, repair-oriented procurement and documentation, stronger technical training, and guidance that aligns conservation practice with climate mitigation and adaptation objectives. The German case offers lessons that are relevant beyond the national context.

Keywords: valuable built environment, heritage refurbishment, sustainable renovation, repair-first, Germany.

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Stakeholder Insights on Sustainable Refurbishment of Valuable Built Environment in Lithuania

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Abstract

As the transition towards climate-neutral and circular construction accelerates across Europe, the refurbishment of heritage and culturally significant buildings remains a complex challenge due to regulatory, economic, and technical constraints. The aim of the study was to assess stakeholder perspectives on the sustainable refurbishment of the valuable built environment (VBE) in Lithuania, developed within the EU-Repair project. The study was based on a stakeholder survey targeting professionals involved in VBE refurbishment, including representatives from public institutions, private sector, and heritage-related fields. The results indicate that while respondents demonstrate a general awareness of refurbishment processes, there is a clear need for deeper knowledge on sustainability-related aspects, particularly risk assessment and integrated approaches. The findings highlight systemic challenges in the Lithuanian context, including unclear or overlapping institutional responsibilities, lack of harmonized guidelines, and weak integration between cultural heritage protection and environmental objectives. Respondents identified high costs, complex permitting procedures, and difficult communication with authorities as the main barriers to implementing refurbishment projects. In practice, stakeholders most frequently apply traditional and energy efficiency-related measures. Moreover, more than half of the respondents do not apply any formal impact assessment methods in their projects. The study also reveals a strong demand for capacity building, particularly in technical refurbishment skills, project management for heritage sites, and climate change mitigation and adaptation strategies. Financial incentives are perceived as the most effective measure to support sustainable refurbishment. Strengthening stakeholder competencies, improving regulatory clarity, and better integrating sustainability into heritage frameworks are essential to unlocking the potential of VBE refurbishment in Lithuania.

Keywords: refurbishment, valuable built environment, climate change, energy efficiency.

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The Research and Application of Medicinal (Aromatic) Plants to Solve Human Health Problems in Various Scientific Fields

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Abstract

Based on the "WHO Global Strategy for Traditional Medicine 2025–2034", the Global Strategy for Plant Protection 2011–2020 and the adopted Convention on Biological Diversity (1993), there is a discussion on the issues of research and rational use of the diversity of medicinal (aromatic) plants (MAPs) and their biologically active substances, in order to optimize a healthy lifestyle [1].

In recent years, much attention has been paid to the research and application of MAPs and the rational and professional use of their raw materials [2, 3].

Scientific Sector of Medicinal and Aromatic Plants Scientific Department Botanical Garden Vytautas Magnus University, with the living MAP's collections, as centre of introduction, research and protection of MAPs, are one of the important links in the conservation of the MAP's diversity, including rare and endangered species [4, 5].

Object of the research and application: diversity of perspective MAPs.

The data of the research were obtained by analyzing the data of Directives, scientific articles and literature sources, applying the theoretical methods of systematic analysis [1, 4, 5, 6].

This scientific Abstract provides detailed information about MAP perspectives and their diversity, the creation of green spaces, and reveals the cognitive importance of MAPs diversity collections in public education activities, personal natural science competencies, taking into account human health problems.

Keywords: research, application, medicinal (aromatic) plants, MAP's, human health.

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Study of the Effect of *Aspergillus niger* on *Pinus* Seeds

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Abstract

Plant pathogenic fungi pose a significant threat to agricultural and forest ecosystems by reducing plant health, germination success, and early seedling development. *Aspergillus niger* is a widely distributed fungal species known for its ability to colonize plant materials and participate in microbial interactions that may influence other microorganisms, and it has been frequently isolated from various nuts in Lithuania, particularly walnuts, pistachios, and hazelnuts, highlighting its relevance to food safety concerns.[1]

In addition, endophytic microorganisms associated with coniferous species such as *Pinus nigra* and *Pinus sylvestris* are considered potential contributors to biological control systems due to their antagonistic properties against fungal pathogens.[2]

This study investigated the effect of *Aspergillus niger* on the germination and early growth of *Pinus nigra* and *Pinus sylvestris* seeds under in vitro conditions. Surface-sterilized seeds were cultured on nutrient media and inoculated with *Aspergillus niger*. Germination rate and early growth parameters, including root length, shoot and needle length, were measured and compared with non-inoculated controls.

The results showed that *Aspergillus niger* significantly reduced seed germination and inhibited early seedling growth in both species. The strongest inhibitory effect was observed in needle development, while root growth was only slightly affected. The impact became more pronounced after 2 weeks, indicating a cumulative effect of fungal exposure. Species-specific responses were also observed, with *Pinus nigra* showing greater sensitivity compared to *Pinus sylvestris*. Remarkably, inoculated seeds of *Pinus nigra* showed reduced levels of secondary fungal contamination compared to controls, suggesting possible competitive interactions between *Aspergillus niger* and other microorganisms present in the seed environment.

Overall, these findings indicate that *Aspergillus niger* shows a growth-inhibitory effect on early conifer development while also influencing microbial dynamics within the seed system. This study provides a basis for further research on microbial interactions in conifer seeds and their potential applications in understanding biological control mechanisms in forest species.

Keywords: *Aspergillus niger*, *Pinus*, seed germination, fungal infection, plant pathology.

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Novel 3-(Diphenylamino)carbazole Compounds for Green TADF OLEDs

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Abstract

High-performance thermally activated delayed fluorescence (TADF) emitters are currently in great demand for applications in full-color displays and solid-state lighting. These materials can reach up to 100% internal quantum efficiency without relying on noble metals. TADF effect enables the upconversion of triplet excitons into emissive singlet states through reverse intersystem crossing (RISC), provided that the singlet-triplet energy gap (ΔE_{ST}) is sufficiently small, and for this goal, a good spatial separation between HOMO and LUMO orbitals is required, which is typically accomplished by incorporating both donor and acceptor moieties into a single molecule using donor-acceptor or donor-acceptor-donor architectures [1-3].

In this study, a new series of 3-(diphenylamino)carbazole-based compounds, RB91, RB92, and RB93, was successfully synthesized and investigated. Thermal analysis revealed that all compounds exhibit remarkable thermal stability, with decomposition temperatures exceeding 350 °C. Additionally, the ability to form stable amorphous films with glass transition temperatures ranging from 90 °C to 145 °C underscores their suitability for device integration. Photophysical and electrochemical studies demonstrated green photoluminescence across the series, with optical bandgaps ranging from 2.66 eV to 3.10 eV, closely linked to the electron-withdrawing character of the respective acceptor moieties. Time-resolved photoluminescence measurements further confirmed efficient fluorescence and TADF, with delayed lifetimes in the microsecond range, indicative of effective triplet harvesting via reverse intersystem crossing (RISC). These findings were supported by theoretical calculations, which offered insights into excited-state behavior, energy level alignment, and potential emission pathways. Among them, RB91 stood out as the most promising emitter. A device incorporating 2 wt% RB91 achieved the highest EQE of 12.87%. Additionally, the device with 4 wt% RB91 exhibited the highest luminance (28,200 cd/m²), and the best current and power efficiencies (37.24 cd/A and 41.34 lm/W, respectively). These exceptional characteristics are attributed to a small ΔE_{ST} of 0.14 eV, short τ_d of 4.40 μs that helps to avoid triplet exciton buildup, and favorable excited-state alignment, which together enhance RISC efficiency and reduce efficiency roll-off, particularly at a higher brightness level of 1000 cd/m². Finally, this study underscores the significance of molecular design and excited-state engineering in developing high-performance multi-channel TADF emitters. RB91, in particular, demonstrates strong potential for application in efficient and stable green TADF OLEDs.

Keywords: electroactive compound, emitter, organic light-emitting diode, carbazole, bipolar derivative.

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Intraspecific Genetic Variation in Lithuanian Populations of *Impatiens noli-tangere* L. and Interspecific Comparison with Congeners

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Abstract

Impatiens noli-tangere, commonly referred to as a touch-me-not balsam, is an annual herbaceous plant belonging to the genus *Impatiens* within the family *Balsaminaceae*. The species is native to parts of Asia, North America and Europe. In Lithuania, it is frequently found in moist habitats, such as forests, shrublands, and along ditches [1]. Several molecular investigations addressing the genetic diversity of *I. noli-tangere* populations have employed nuclear DNA markers [2-4]. Compared with nuclear and mitochondrial genomes, chloroplast genome is structurally simpler and highly conserved. Moreover, it exhibits maternal inheritance, relatively independent evolution and low requirements for DNA sample quality [5]. Consequently, chloroplast genome has become widely used in molecular research, playing a key role in the analysis of plant genetic diversity, phylogenetic relationships, species identification, evolutionary studies, taxonomic refinement and germplasm characterization [6, 7]. Chloroplast DNA is commonly applied in phylogeographic studies of plant invasions, as well as for examining differences in genetic variation between native taxa and their invasive relatives, helping to clarify the evolutionary and ecological factors that promote invasiveness [8]. Although chloroplast genome sequencing has recently been conducted in a number of *Impatiens* species [6, 9], studies specifically addressing the chloroplast DNA of *Impatiens noli-tangere* remain limited compared to its congeners [10]. This study aims to evaluate the genetic diversity of Lithuanian populations of *Impatiens noli-tangere* L. using chloroplast DNA markers and to compare these patterns with those observed in related congeneric species. Plant material was collected from multiple regions across Lithuania, followed by DNA extraction and assessment of its quality and concentration. A subset of individuals was analysed using the chloroplast regions *rpl32-trnL*, *rps16*, *trnG* and *psbA-trnH*, selected for their high variability in *Impatiens glandulifera* [11]. Comparative analysis among populations revealed the presence of single nucleotide polymorphisms in the *rpl32-trnL* and *rps16* regions, indicating genetic differentiation, while no variation was observed in *psbA-trnH* and *trnG* regions. Additionally, sequences of the *psbA-trnH* and *trnG* regions obtained for *I. noli-tangere* were compared with those of related *Impatiens* species [11-13]. Phylogenetic analysis demonstrated that *I. noli-tangere* is more closely related to *I. capensis* and *I. parviflora* than to *I. glandulifera*. These finding suggest that future studies should include a larger number of populations to more comprehensively characterize chloroplast DNA variation in *Impatiens noli-tangere*.

Keywords: native species, chloroplast DNA markers.

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Bioactive Pigment-Integrated Fungal Bio-Composites for Sustainable Material Development

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Abstract

The rising demand of multifunctional and sustainable materials has driven interest in bio-based alternatives from renewable resources. This study proposes a conceptual framework for the development of bioactive pigment-integrated fungal bio-composite. The fabrication strategy for bio-composite development is based on solid-state culture of white rot Basidiomycetes on agro-industrial wastes as straw, sawdust, and spent coffee grounds. The framework uitlizes *Pleurotus ostreatus* and *Irpex lacteus* for their lignocellulolytic capabilities and a comparative evaluation of fungal growth behaviour and enzyme activity profiles is proposed to identify optimal substrate- fungus combination for efficient bio-composite formation. Parallelly, submerged cultivation of pigment producing ascomycetes are considered for obtaining bioactive pigment fractions. The approach aims to obtain a diverse spectrum of naturally derived pigments, representing different colour classes. These pigments are intended to be integrated into the bio-composite matrix to develop functional materials with potential bioactive properties. Furthermore, evaluation of the developed bio-composites in terms of micromechanical properties, to understand the relationship between internal morphology and material performance. Thermal behaviour and overall material stability are assessed to determine suitability for sustainable applications. This work presents an integrated and interdisciplinary approach combining fungal biotechnology, waste valorization, and functional material design, contributing to the advancement of eco-friendly and value add biomaterials with circular bioeconomy framework.

Keywords: *Pleurotus ostreatus, Irpex lacteus,* coffee beans spent, substrate, bio-composite, ascomycetes, fungal pigments, HPLC, spectroscopy.

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Cyanopyridine-Based Compounds as Green TADF Emitters and Sensitizers for Efficient NIR Emission

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Abstract

At present, there is an intensive need for high-performance TADF emitters in full-color display and solid-state lighting. Such compounds can achieve up to 100% internal quantum efficiency without the use of noble metals. However, lack of efficiency still persists because of slow and inefficient reverse intersystem crossing (RISC), making it difficult to achieve a high efficiency altogether [1]. Herein, we introduce two cyanopyridine electron acceptor and 3,6-bis(diphenylamino)carbazole electron donor having green thermally activated delayed fluorescence (TADF) emitters, 5Py2CN-CzDPA and 2Py4CN-CzDPA, with a focus on how subtle positional modifications of the acceptor unit influence photophysical behavior and device performance. Both compounds were prepared via nucleophilic substitution in anhydrous DMSO using vacuum-dried K_2CO_3 under nitrogen. Reactions of 3,6-bis(diphenylamino)-9*H*-carbazole with excess 2-cyano-5-fluoropyridine or 4-cyano-2-fluoropyridine at 155 °C for 24h yielded CzDPA-5Py2CN and CzDPA-2Py4CN, respectively. Thermal analysis (TGA/DSC) showed high thermal stability, with T_d values of 379 °C (CzDPA-5Py2CN) and 339 °C (CzDPA-2Py4CN). Both compounds were initially crystalline, melting at 171 °C and 268 °C, respectively, and forming amorphous phases upon cooling with T_g values of 129 °C and 113 °C. These results indicate good thermal stability and suitability for stable amorphous films. Thin-film characterization reveals that both emitters exhibit high photoluminescence quantum yields, small singlet-triplet energy gaps ($\Delta E_{ST} \approx 0.10$-0.19 eV), and pronounced delayed fluorescence [2], confirming efficient reverse intersystem crossing [3] for TADF process to occur. Despite comparable intrinsic photophysical properties, significant differences arise in device performance. OLEDs based on 5Py2CN-CzDPA achieve a maximum external quantum efficiency (EQE) of 17.9%, substantially outperforming 2Py4CN-CzDPA-based devices (8.4%), primarily due to improved radiative efficiency and carrier transport balance. These emitters were further employed as sensitizers to drive near-infrared (NIR) emission using commercial APDC-DTPA as emitter, enabling efficient exciton generation and energy transfer [4], achieving NIR emission at 760.5 nm with a high EQE of 4.13%, among the best reported in this spectral region. Overall, when incorporated into appropriately engineered device architectures, CzDPA-5Py2CN delivers significantly higher green electroluminescence efficiency than CzDPA-2Py4CN, highlighting the critical role of subtle molecular structural tuning in governing device performance. Beyond conventional green OLEDs, both materials can also function as effective sensitizers within a TADF–TADF sensitization strategy, enabling efficient triplet management and extended-wavelength electroluminescence. Overall, this work demonstrates that minor positional modifications in green TADF emitters can yield comparable intrinsic photophysics while exerting a disproportionate impact on device efficiency, underscoring the importance of rational molecular design in advanced OLED architectures.

Keywords: OLED, TADF, NIR emission.

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Poly(2-Alkyl-2-Oxazoline)-Coated Gold Nanospheres as Novel Agents for Photothermal Antitumor Therapy

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Abstract

Gold nanoparticles have great potential as agents for photothermal therapy [1, 2]. However, the successful therapeutic application of these nanoparticles depends strongly on the design of the surface coating, which must provide colloidal stability, prolong circulation, and promote effective accumulation in tumor tissue. Polyethylene glycol (PEG), a common coating for nanoparticles, can cause unwanted immune responses and allergic reactions. Therefore, poly(2-oxazoline) (POx) is an excellent PEG replacement because it is more biocompatible, and its side chains and end groups can easily be modified to introduce target ligands. This study evaluated the cytotoxicity and intracellular distribution of poly(2-alkyl-2-oxazoline)-coated gold nanospheres (AuNSs) as novel agents for PTT.

The HeLa, B16F10, and HEK293 cell lines were treated with poly(2-methyl-2-oxazoline)- and poly(2-ethyl-2-oxazoline)-coated AuNSs (PMeOx@AuNSs and PEtOx@AuNSs, respectively) at concentrations ranging from 0 to 200 μM. After a 24-hour post-incubation, cell viability was determined using a resazurin assay. A concentration of 50 μM of AuNSs was used to treat the cells for transmission electron microscopy (TEM). Following a 24-hour incubation period, the cells were fixed with 2.5% glutaraldehyde in a 0.1 M phosphate buffer solution and prepared for TEM.

HEK293 cells were more sensitive to the toxic effects of the studied AuNSs, which affected them at concentrations of 50 μM and above. Meanwhile, treatment of HeLa and B16F10 cells resulted in statistical cytotoxic effects at concentrations of 75 and 100 μM, respectively. TEM images revealed that the POx-coated AuNSs were homogeneous, with an average size of ~7 nm. 24 hours after treatment with AuNSs, the nanoparticles are internalized by the cells through endocytosis and accumulate in dense clusters inside intracellular vesicles. These vesicles have distinct limiting membranes, indicating localization in endosomes or lysosomes.

POx-coated AuNSs are effectively taken up by cancer cells and primarily localize in endosomal and lysosomal compartments, which is typical for nanoparticle internalization. Although cell sensitivity varies depending on the cell line and concentration, nanoparticles generally remain well-tolerated at moderate doses. These findings suggest that POx coating helps preserve the stability and biocompatibility of nanoparticles while facilitating successful intracellular delivery.

POx-coated AuNSs demonstrate good cellular compatibility and clear intracellular uptake. These properties make them promising candidates for photothermal antitumor applications. Their localization within intracellular vesicles indicates that they can be accumulated in a controlled manner before light activation.

Keywords: gold nanospheres, poly(2-alkyl-2-oxazoline), cancer, photothermal therapy.

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Effect of Gellan Gum Concentration on the Mechanical Properties of Edible Gels with Linden Honey and Chaga Powder

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Abstract

Gels represent an intermediate state between solid and liquid phases, exhibiting both elastic behavior characteristic of solids and flow properties typical of liquids. They possess a three-dimensional network structure capable of entrapping and retaining substantial amounts of water, air, or oil within the matrix [1]. Gellan gum is a linear, negatively charged exopolysaccharide classified as a polyanion. It consists of repeating tetrasaccharide units composed of two β-D-glucose residues, one β-D-glucuronate residue, and one α-L-rhamnose residue. Glucose accounts for approximately 60% of the polymer mass, while rhamnose and glucuronate each contribute about 20% [2]. The aim of this research was to investigate how different concentrations of gellan gum influence the mechanical properties of edible gels, including hardness, firmness, elasticity, and adhesiveness.

Edible gels were prepared by dissolving 0.4, 0.5 and 0.6 g of gellan gum in 100 mL of water and heating to 100 °C to ensure complete polymer hydration and swelling. Separately, linden honey was warmed to 40 °C and mixed with chaga (*Inonotus obliquus* (Ach. ex Pers.) Pilát) powder, followed by incorporation of the cooled gellan gum base. The gel mass was further enriched with ascorbic acid, citric acid, sodium benzoate, and glycerol, added gradually while stirring. The mixtures were homogenized and poured into airtight containers, resulting in uniform and structurally stable gels. This approach allowed optimization of gel texture and consistency, producing edible gels with enhanced structural and functional properties. All prepared gels were stored under identical conditions: at room temperature (20±5 °C), in a dry, sun-protected environment. The physical properties of the different gels were evaluated with TA.XT.plus („Texture technologies“, NY, USA), including firmness, consistency, cohesiveness and viscosity.

Texture changes of edible gels were evaluated immediately after preparation and following 1 and 4 months of storage under identical conditions. After 1 month, a slight increase in firmness was observed in all samples, most notably in the GG (gellan gum) 0.4 gel, which increased from 22.23±3.36 g to 24.17±2.40 g, while GG 0.5 and GG 0.6 remained relatively stable (from 22.06±3.12 g to 21.59±3.40 g and from 23.21±4.88 g to 22.68±4.07 g, respectively). Consistency also increased in the GG 0.4 sample (397.15±58.39 g. sec to 450.78±60.91 g. sec), whereas higher-concentration gels showed only minor changes, indicating greater initial structural stability. After 4 months, gels with lower GG concentrations exhibited reductions in both firmness and consistency (GG 0.4 20.60±2.77 g and 364.85±64.97 g; GG 0.5 21.15±3.19 g and 376.42±61.32 g), while the highest-concentration gel (GG 0.6) displayed significant decreases in cohesiveness (11.42±4.90 g to 7.31±4.17 g) and viscosity (4.64±5.27 g. sec to 1.30±1.21 g. sec), suggesting structure densification and potential water migration.

In conclusion, increasing gellan gum concentration improved the mechanical strength of edible gels with linden honey and chaga powder, but long-term storage revealed that higher-concentration gels were more prone to elasticity loss, whereas lower-concentration gels were more susceptible to structural destabilization. These results highlight the importance of optimizing gellan gum concentration to balance gel strength, elasticity, and stability during storage.

Keywords: edible gels, honey, gellan gum, *Inonotus obliquus.*

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Synthesis, Spectroscopic Characterization, and Biological Evaluation of a Lactoferrin-Oxaliplatin Complex for Targeted Oral Delivery

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Abstract

Oxaliplatin is a third-generation platinum-based anticancer drug. Relative to cisplatin, it displays lower reactivity and a more favorable toxicity profile. Like other platinum-containing chemotherapeutics, oxaliplatin is administered intravenously. Its pharmacokinetic behavior involves a short distribution phase and a prolonged terminal elimination phase [1]. Nevertheless, its clinical application remains constrained by dose-limiting toxicity, particularly peripheral sensory neuropathy, as well as by the development of treatment resistance. To overcome these challenges, efforts have been directed toward the development of an oral delivery strategy for oxaliplatin. Such an approach is based on the use of a protein carrier capable of interacting with intestinal epithelial cells, thereby improving drug uptake and supporting targeted anticancer therapy. In this study, lactoferrin was investigated as a potential carrier molecule. Lactoferrin is an iron-binding member of the transferrin family with recognized biological and therapeutic relevance. Because lactoferrin receptors are expressed on many cell types, including intestinal epithelial cells [2]. Importantly, lactoferrin has also been shown to possess anticancer activity, chemopreventive potential, and synergistic effects when combined with anticancer agents [3].

This study aimed to synthesize and comprehensively characterize a lactoferrin–oxaliplatin complex. To confirm the formation of the complex and evaluate its physicochemical properties, a combination of complementary analytical techniques was employed, including Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy, UV-Vis spectroscopy, inductively coupled plasma optical emission spectrometry (ICP-OES), dynamic light scattering (DLS), native electrophoresis, and SDS-PAGE. These methods enabled the assessment of structural features, metal content, particle size distribution, and protein integrity following complexation. The biological activity of the obtained complex was subsequently investigated by evaluating its cytotoxic effects *in vitro*. For this purpose, the MTT assay was performed using two cell lines, Caco-2 (intestinal epithelial cells) and HepG2 (hepatocellular carcinoma epithelial-like cells). This approach allowed for a preliminary assessment of the potential biological relevance of the lactoferrin-oxaliplatin complex.

Keywords: bovine lactoferrin, oxaliplatin, chemotherapy.

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Potential of *Aegopodium podagraria* L. in Enhancing Antibiotic Efficacy Against Selected Bacterial Strains

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Abstract

The increasing antimicrobial resistance (AMR) of pathogenic bacteria has emerged as one of the most critical public health challenges, featured prominently on the World Health Organization's (WHO) list of priority threats [1]. The widespread misuse of antibiotics has led to a significant loss of pathogen sensitivity, which complicates the treatment of infectious diseases. Therefore, researchers are looking for ways to enhance antibiotic efficacy. Recent studies suggest that herbal extracts, when used in combination with antibiotics, can increase their effectiveness [2].

Thus, the aim of this study was to evaluate the combined antimicrobial effects of extracts from leaves, stems and flowers of *Aegopodium podagraria* L. and antibiotics oxytetracycline, ceftazidime and penicillin. The research focused on four bacterial strains included in the WHO 2024 priority pathogen list [3]. The antimicrobial activity was assessed using agar well diffusion assay, with the combined effect evaluated by measuring inhibition zone diameters (mm).

The results indicated that *A. podagraria* extracts can significantly modulate the efficacy of antibiotics, depending on the specific plant part and bacterial strain. The most pronounced enhancement was observed against *P. aeruginosa,* where the flower extract increased the inhibition zone of oxytetracycline by 60%. In approximately 30% of the tested combinations, an additive effect was observed.

In conclusion, this study demonstrated that natural plant extracts can increase the effectiveness of antibiotics even against resistant bacterial strains. These findings support the potential of *A. podagraria* in combination therapy in the fight against antimicrobial resistance.

Keywords: *Aegopodium podagraria* L., antimicrobial resistance, antibiotics, synergy.

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Activity of Metal and Metal Oxide Nanoparticle-Enhanced Cotton Material Against Fungi of the *Malassezia pachydermatis*

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Abstract

Malassezia pachydermatis is a commensal microorganism found on the skin and mucous membranes of healthy animals [1]. However, it is responsible for *Malassezia* dermatitis, especially in dogs with underlying conditions, as these yeasts proliferate and induce disease when the normal skin balance is disrupted by factors such as allergies, endocrine disorders, or other skin diseases [2]. Although *M. pachydermatis* is usually treatable, repeated or improper treatment may lead to resistance to multiple azoles (e.g., fluconazole, itraconazole, ketoconazole) [3].

It was reported that different metal nanoparticles exert antifungal effects on *M. pachydermatis* through mechanisms such as ion release, oxidative stress induction, membrane disruption, and interference with virulence factors, with zinc oxide and silver nanoparticles showing the most promising balance of efficacy and clinical applicability [4, 5].

This study aimed to evaluate the antimicrobial activity of cotton material functionalized with metal- and metal oxide-nanoparticles against the yeast *M. pachydermatis.* The *Malassezia* species was determined using MALDI-TOF mass spectrometry. Metal oxides (CuO, WO_3, AgO, Fe_2O_3, ZnO, SiO_2, CeO_2), along with Mg and Fe nanoparticles (NPs), were deposited on one side of the cotton material using low-temperature plasma technology in a pure oxygen or argon atmosphere. To assess the antimicrobial activity of metals and metal oxide nanoparticles against clinical canine isolates, the broth microdilution method was employed.

The strongest inhibitory effect was observed with CuO and AgO, which suppressed approximately 90% of yeast growth. Moderate activity was recorded for Fe_2O_3, ZnO, CeO_2, and Mg-enhanced cotton materials, with inhibition ranging from 55% to 69%. The weakest antifungal activity was observed by WO_3 and Fe metal nanoparticles (from 15% to 38%), whereas SiO_2 *activated the growth of M. pachydermatis* by 13%.

The research results are promising due to the strong performance of CuO and AgO metal nanoparticles embedded in cotton textile; however, further studies are needed to evaluate the *in vivo* safety and efficacy of the nanoparticles.

Keywords: metal nanoparticles, metal oxide nanoparticles, antimicrobial activity, *Malassezia pachydermatis*, cotton textiles, plasma technology.

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Novel 3-Ethylcarbazole-Based Host Materials for High-Efficiency OLEDs

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Abstract

In recent years, organic light-emitting diodes (OLEDs) have attracted strong interest from both academia and industry because of their design versatility and potential as efficient, sustainable light sources, creating an ever-growing demand for new high-performance materials. Carbazole represents one of the most commonly used electron-donating fragments in host design due to its high triplet energy, thermal and oxidative stability, favorable charge-transport properties, and extensive functionalization potential. Numerous high-performance hosts have been derived from carbazole-based frameworks, and structural modifications, such as *N*-substitution, substitution at the *3,6*-positions, or expansion into bi- or tricarbazole units, have proven effective in tuning solubility, rigidity, and charge mobility [1-3]. To further achieve these properties, carbazole units are typically combined with suitable electron acceptors, which play a decisive role in defining the photophysical and charge-transport characteristics of the resulting host materials. Diphenylsulphone and diphenylmethanone moieties have emerged as particularly promising acceptor units due to their strong electron withdrawing ability, high thermal stability, and compatibility with donor-type molecular architectures [4-5].

In this study, four new ethylcarbazole-based D-A-D host materials, CzeCzS, eCz2S, CzeCzM, and eCz2M, were successfully synthesized by combining carbazole electron donors with either diphenylmethanone or diphenyl sulfone electron acceptors, and were evaluated for their suitability in OLED applications. Photophysical measurements revealed high triplet-state energies (2.71–2.90 eV), indicating that these compounds can effectively serve as hosts for both green phosphorescent and yellow thermally activated delayed fluorescence (TADF) emitters. When applied as host materials for green phosphorescent emitters, the newly synthesized phenylsulfonyl and methanone derivatives achieved maximum external quantum efficiencies (EQEs) of 14.0% and 16.5%, respectively. Furthermore, incorporating these hosts into blended co-host architectures results in EQE values exceeding 20%. The best-performing device, based on the eCz2M: B3PyMPM co-host system, achieved an EQE of 20.3%, a luminance efficiency (CE) of 72.7 cd/A, and a power efficiency (PE) of 95.1 lm/W, and the efficiency was retained even in higher luminance with EQE of 19.1% at 1000 cd/m2 for CzeCzM: B3PyMPM-based device. Also, for the yellow-emitting TADF OLED prototype, our co-host systems enabled to achieve an EQE of 10.3%.

Finally, this study demonstrates that methanone-bridged ethylcarbazole D-A-D structures are strong candidates for next generation high-performance OLED host materials. The combined insights into molecular design, thermal, and morphological stability, and device characteristics provide fundamental knowledge for developing advanced host materials for both TADF and phosphorescent OLED technologies.

Keywords: carbazole, electroactive compound, host material, organic light-emitting diode.

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Effect of Lactoferrin Powder and Solution on the Growth of Food-Associated Gram-negative Bacteria

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Abstract

Lactoferrin is an iron-binding glycoprotein naturally present in mammalian secretions, including milk, and is widely recognized for its antimicrobial properties [1]. The production of lactoferrin-enriched powders, however, poses significant microbiological challenges, as powdered dairy products are inherently non-sterile and may serve as vectors for foodborne pathogens if improperly processed or stored. This is particularly critical for Gram-negative bacteria, such as *Escherichia coli*, *Salmonella*, which are common contaminants in dairy products and can cause serious foodborne illness [2].

In this study, we determined the time required for complete neutralization of *E. coli* ATCC 39876 11778 and *S. enterica subsp. enterica* PCM 2565 cells by lactoferrin in two physical forms: powder and aqueous solution. This approach enabled a comparative assessment of antimicrobial kinetics depending on the matrix and availability of the active compound.

Lyophilized cells of *E. coli* ATCC 39876 and *S. enterica subsp. enterica* PCM 2565 were incorporated into two distinct systems: lactoferrin powder and a 10% (w/v) aqueous solution of lactoferrin. The samples were preserved under controlled conditions for two months to assess the survival and inactivation kinetics of the microorganisms under investigation. At defined time points, samples were plated onto Mueller-Hinton agar, incubated, and the resulting colonies were counted and expressed as colony-forming units (CFU).

Results show, that after one month of storage, no viable cells of *E. coli* or *S. enterica* were detected in the lactoferrin powder, indicating complete loss of culturability under these conditions. In contrast, in the aqueous lactoferrin solution, both microorganisms remained detectable, although their survival was markedly reduced, over 95% decrease of CFU.

These findings demonstrate that the antimicrobial effectiveness of lactoferrin is strongly dependent on its physical form, which is particularly relevant in the context of food safety. While lactoferrin in powder form can effectively inactivate Gram-negative bacteria, subsequent processing—such as dissolving the powder into solutions—may reduce its antimicrobial activity and create conditions that allow bacterial survival or growth. Therefore, appropriate monitoring and control measures are essential to ensure the safety of lactoferrin-containing food products.

Keywords: lactoferrin, milk powders, G (-) bacteria, survival, food safety.

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Characterisation of Phytochemical Diversity in *Chrysanthemum morifolium* Residual Biomass

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Abstract

As the demand for natural active ingredients grows, the production of these products could intensify, which can elevate the risk of natural resource overuse. The circular economy is considered one of the solutions to foster sustainability, savings in time and energy, reducing negative environmental impacts, and encouraging the reuse of materials for the production of new products [1]. Medicinal plants are rich in secondary metabolites and are important natural resources applied in the pharmaceutical, food, cosmetic and pesticide industries [2]. Recent studies have shown that, in addition to the well-known medicinal chrysanthemum species, ornamental cultivars also have very high potential for future applications and also have significant potential for the cosmetic industry [3]. Ornamental chrysanthemum cultivars, particularly their flowers, leaves and stems, are distinguished by their phytochemical diversity, which includes flavonoids, phenolic acids, alkaloids, tannins, terpenoids, polysaccharides and several essential oils [4], [5]. Due to their pharmacological properties, these compounds have antimicrobial, anticancer, antioxidant, antifungal, analgesic, antiinflammatory, and anticonvulsant activities [4]. Consequently, *Chrysanthemum morifolium* extracts are used in topical cosmetic products as anti-aging, anti-wrinkle and anti-pigmentation agents [6]. The aim of the study was to evaluate the antioxidant activity of *Chrysanthemum morifolium* residual biomass (unsold or substandard biomass), obtained from a floriculture farm by comparing the responses among different genotypes and plant organs.

Chrysanthemum morifolium cultivars were grown in an open-field floriculture farm. Cuttings were cultivated in a peat substrate using seedling trays. After 3-4 week, seedlings were transplanted into a 2 L plastic pots. Plants were watered to maintain moisture as needed and fertilized daily with NPK 6-14-30 starting from the third week after transplanting. Plants were cultivated until the flowering stage. Plant material was collected in October 2025. Fresh (FW) and dry (DW) plant weights were measured using an electronic scale before and after tissue dehydration by freeze-drying. Antioxidant properties were evaluated using DPPH, ABTS free radical scavenging activities assays, ferric reduction antioxidant power (FRAP), and total phenolic content (TPC) determined by spectrophotometric methods. The obtained results will be presented to compare the phytochemical composition of various plant organs from the residual biomass of different *Chrysanthemum morifolium* genotypes, and to assess their potential applications in the cosmetics and pharmaceutical industries, and support the principles of the circular economy.

Keywords: antioxidant activity, circular economy, chrysanthemums, DPPH, ABTS, FRAP, TPC.

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Feeding Pressure-Dependent Transition in Critical Translation Speed for Melt Electrowriting of Tissue Engineering Scaffolds

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Abstract

Melt electrowriting (MEW) is a high-precision additive manufacturing technique increasingly applied in tissue engineering for the fabrication of microfibrous scaffolds. Poly-ε-caprolactone (PCL) is widely used in biomedical 3D printing due to its biocompatibility, biodegradability, and suitability for tissue regeneration applications [1]. Importantly, successful cell integration depends not only on the material itself but also on scaffold architecture, including fiber diameter and geometry, as cells are highly sensitive to their microenvironment. Therefore, precise control over fiber deposition is essential for achieving optimal biological performance [2]. A key parameter governing fiber deposition accuracy in MEW is the critical translation speed (CTS), defined as the minimum collector velocity required to obtain straight and continuous fibers. CTS depends on both processing parameters and material properties [3]. Therefore, a deeper understanding of how feeding pressure influences the CTS transition and the resulting fiber geometry is essential for achieving reliable and precise control of scaffold architecture in MEW.

In this study, the influence of feeding pressure on CTS and fiber diameter was investigated using PCL as a model polymer. MEW printing was performed at three feeding pressures (40, 45, and 50 kPa) under constant voltage (3.0 kV), temperature (95 °C), and working distance (1 mm). CTS was determined experimentally by identifying the transition from sinusoidal to straight fiber morphology, while fiber diameters were evaluated from scanning electron microscopy (SEM) images.

The results demonstrated a decrease in CTS with increasing feeding pressure, from 0.47 ± 0.01 mm/s at 40 kPa to 0.25 ± 0.01 mm/s at 50 kPa, indicating that higher pressure enhances polymer jet flow and reduces the collector speed required for stable fiber deposition. SEM analysis confirmed that fibers printed at or above CTS exhibited straight, continuous morphology, whereas sub-CTS conditions resulted in sinusoidal patterns. Additionally, fiber diameter increased with increasing feeding pressure, reflecting higher volumetric flow rates of the molten polymer.

These findings highlight feeding pressure as a critical parameter influencing CTS and fiber morphology in MEW. Improved understanding of these relationships enables more precise control of scaffold architecture, which is essential for designing biomaterials with enhanced cell compatibility and functionality in tissue engineering applications.

Keywords: melt electrowriting, critical translation speed CTS, polycaprolactone PCL, tissue engineering, scaffold architecture.

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Research on the Distribution of Electric Field in Tissues After Electric Field Application

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Abstract

Electroporation is a well-established bioelectrical phenomenon characterized by the formation of transient or permanent nanopores in the cell membrane under the influence of pulsed electric fields, enabling controlled molecular transport or targeted tissue ablation [1–3]. Despite its widespread application in electrochemotherapy, gene delivery, and tissue engineering, precise control of electric field distribution within heterogeneous tissues remains a significant challenge [2,4]. This study aims to investigate the spatial distribution of electric fields in tissue models and evaluate the influence of hydration on electroporation efficiency.

A potato tissue model was employed due to its structural and electrical similarity to soft biological tissues. Experiments were conducted using parallel titanium electrodes with a fixed inter-electrode distance of 2 mm. Pulsed electric fields of 1.2, 2.4, and 3.6 kV/cm were applied under controlled conditions. Samples were categorized into dry and hydrated (deionized water-immersed) groups. Electrical resistance measurements were performed using an ohmmeter, while electroporated regions were visualized and quantified using MTT staining as an indicator of metabolic activity and cell viability. The results revealed that samples immersed in deionized water exhibits smaller electroporated regions compared to dry samples, likely to due the dilution of ions, which reduces tissue conductivity and limits effective electric field propagation. In other hand dry samples demonstrated larger electroporated areas, indicating a stronger electroporation effect under the applied conditions. Additionally, aged or dehydrated tissues showed negligible electroporation effects, due to compromised membrane integrity. These findings highlight the critical role of tissue conductivity and water content modulating electric field propagation within a tissue.

In conclusion, this study demonstrates that tissue hydration, particularly through deionized water immersion, significantly influences electric field distribution and electroporation efficiency by reducing ionic concentration and limiting effective field propagation. In contrast, dry tissues exhibit stronger electroporation effects, emphasizing the role of ionic content in treatment outcomes. These findings contribute to the optimization of electroporation-based biomedical applications, where precise control of treatment zones and minimization of collateral damage are essential.

Keywords: electroporation, electric field distribution, tissue hydration, potato tissue model, MTT assay, bioelectricity.

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Tailoring Non-Linear Optical Properties of Dicyanoisophorone Derivatives via Donor-Modulation

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Nonlinear optical (NLO) materials with enhanced first hyperpolarizability β are useful for advanced photonic technologies, particularly for laser applications where they enable efficient nonlinear light amplification and frequency conversion [1-3]. Despite of all advancements in this field, the characteristics of the current systems remain below theoretical limits. This concerns the assessment of static and dynamic hyperpolarizabilities within Kuzyk's framework and highlights significant scope for optimization. In this work, we report on the new family of dicyanoisophorone-based chromophores designed to modulate charge-transfer characteristics and optimize NLO responses [4]. These structurally related systems, despite minimal absorption spectral variation ($\Delta\lambda \leq 23$ nm), exhibit a wide range of dynamic β_{HRS} values from 156 to 787×10^{-30} esu. By integrating thianthrene and phenoxathiine donor moieties, we systematically compare twisted intramolecular charge transfer (TICT) and hybrid local and charge transfer (HLCT) excited states within donor-acceptor architectures. HLCT exhibiting chromophores show higher β responses, while TICT showing systems display reduced β_{HRS} (555-577×10^{-30} esu) due to disrupted π-conjugation despite large transition dipole moments (≈38-39 D). Depolarization ratios measurement results confirm dominant 1D dipolar character. Dynamic β_{zzz} values showed up to 3.4-fold reduction in TICT systems, whereas static β remains comparatively unaffected. These findings demonstrate that excited-state engineering, rather than simple π-extension, governs NLO efficiency and provides a rational design strategy for high-performance NLO materials.

Keywords: non-linear optics, dicyanoisophorone, charge transfer, depolarization ratio.

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Bridging Molecular Targeting and electrochemical Sensing with Polydopamine-Based Imprinted Sensors for Tetracycline Detection

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Abstract

The essential feature of molecularly imprinted polymers (MIPs) the specific molecular recognition sites. The integration of MIPs as a recognition element, combined with a portable screen-printed electrode (SPE) as an electrochemical transducer, offers a practical strategy for routine environmental analysis [1].

Tetracycline (TC) is a principal class of antibiotics. Because of its extensive use, TC has attracted significant attention due to its notable ecological and human health risks. The accurate detection of TC is highly significant for pharmaceutical quality control, food safety, and environmental monitoring. Routinely used TC detection methods have certain drawbacks, including complex operation, expensive instrumentation, and time-consuming protocols [2]. Therefore, a combination of MIP-based platforms with portable electrochemical systems may offer a selective, sensitive, and rapid analysis of tetracycline residues in complex matrices.

In this work, a MIP-based sensor was prepared for the selective determination of TC, using dopamine hydrochloride as the functional monomer and TC as the template, thereby generating recognition sites complementary to the target's molecular structure. MIP fabrication was performed via drop-casting of polydopamine nanoparticles synthesized via auto-oxidation of dopamine hydrochloride in tris buffer (pH 8.5) and electrochemical polymerization via cyclic voltammetry in phosphate-buffered saline (PBS, pH 7.4), with TC. Non-imprinted polymers (NIPs) were prepared using the same procedure but without a template and served as a control. Template removal was performed by solvent washing with an ethanol-acetic acid mixture (9:1, v/v). Rebinding studies using electrochemical techniques, including cyclic voltammetry and electrochemical impedance spectroscopy, confirmed that MIPs exhibited higher sensitivity to TC than NIPs, demonstrating the system's potential.

Keywords: molecular imprinted polymers (MIPs); tetracycline; electrochemical impedance spectroscopy (EIS).

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Survival of Foodborne Gram-Positive Bacteria in Lactoferin Powder and Solution

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Abstract

Lactoferrin is a multifunctional protein that plays a significant role in the immune response and possesses antimicrobial properties [1]. Despite its beneficial properties, the microbiological quality of lactoferrin-containing milk powders must be monitored closely. The presence of lactoferrin does not negate the need for stringent microbiological standards, as the protein itself can be a substrate for microbial growth if not handled properly. Particular concern is associated with spore-forming bacteria such as *Bacillus cereus* and psychrotrophic pathogens like *Listeria innocua*, which are commonly used as indicator organisms in food safety studies [2][3].

In this study, we determined the time required for neutralization of *B. cereus* ATCC 11778 and *L. innocua* ATCC 309 cells by lactoferrin in two physical forms: powder and aqueous solution. This approach enabled a comparative assessment of antimicrobial kinetics depending on the matrix and availability of the active compound.

The experiment was conducted over a period of two months. Lyophilized cells of *B. cereus* and *L. innocua* were introduced into two systems: lactoferrin powder and a 10% (w/v) aqueous lactoferrin solution. The samples were stored under controlled conditions for the duration of the study to evaluate the survival and inactivation dynamics of the tested microorganisms. At defined time intervals, samples were collected and plated onto Mueller-Hinton agar as well as selective media Brilliance Listeria agar base, and M.Y.P. Agar Base in accordance with ISO 11290-1 and ISO 7932. After incubation, the number of grown colonies was determined, and results were expressed as colony-forming units (CFU), enabling quantitative assessment of bacterial survival and neutralization over time.

Both strains showed rapid growth during the first two days in both lactoferrin powder and solution, followed by a decline. The obtained results indicated high survival of both tested strains throughout the storage period, regardless of the lactoferrin form applied. After two months the survival rate of the tested strains was approximately 10%. These findings suggest that, under the tested conditions, lactoferrin alone may not ensure complete inactivation of the studied microorganisms.

In conclusion, the study provides important insight into the antimicrobial activity of lactoferrin in different matrices; however, it also highlights that the presence and persistence of *B. cereus* and *L. innocua* in lactoferrin-enriched products may pose a potential health risk if proper microbiological control is not maintained. Therefore, strict monitoring in accordance with established standards remains essential to ensure product safety and compliance with microbiological criteria.

Keywords: lactoferrin, milk powders, G(+) bacteria, survival, food safety.

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Determination of the antiradical activity *in vitro* of *Chaenomeles japonica* (Thunb.) Lindl. ex Spach fruit extracts using the spectrophotometric TFPH assay

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Abstract

Japanese quince (*Chaenomeles japonica* (Thunb.) Lindl. ex Spach) is a decorative shrub species from the Rosaceae family [1]. Besides its decorative value, Japanese quince is rich in biologically active compounds, including phenolics, ascorbic acid, and triterpenic acids such as oleanolic, and ursolic acids. Since fruits are consumed as food products, they may also exhibit notable antioxidant activity. Antioxidants play an essential role in reducing oxidative damage by scavenging free radicals – highly reactive molecules that can negatively affect cellular structures like lipids, proteins, and DNA. Consequently, these compounds may help decrease the likelihood of developing chronic conditions, including cardiovascular diseases, cancer, diabetes, and neurodegenerative disorders [2]. This study aimed to investigate the *in vitro* antiradical capacity of Japanese quince fruit samples.

Fruit samples of Japanese quince were obtained from 11 distinct locations across Lithuania. For extraction, 1 g of lyophilized fruit material was transferred into dark glass bottles and extracted with 10 ml of acetone (100%, v/v). The samples were sonicated for 15 min in an ultrasonic bath (565 W, 80 kHz). Antiradical activity *in vitro* was assessed using the TFPH assay: 10 µl of fruit extract was mixed with 3 ml of freshly prepared TFPH working solution and incubated in the dark for 30 min. Absorbance was recorded at 502 nm using a UV–Vis spectrophotometer [3].

The measured antiradical activity of the samples varied between 14.27 and 145.64 µmol TE/g depending on the region of origin. The highest antiradical activity *in vitro* (145.64±1.02 µmol TE/g) was found in *C. japonica* fruit samples collected in Vilnius district and did not differ statistically significantly from those of samples collected in Rokiškis (142.52±5.19 µmol TE/g), Biržai (139.45±6.21 µmol TE/g) or Kaišiadorys (128.30±11.17 µmol TE/g) districts. The lowest activity *in vitro* was observed in Japanese quince fruit samples from Telšiai (14.27±2.32 µmol TE/g) and Šiauliai (25.90±5.10 µmol TE/g) districts. The overall mean antiradical activity reached 102.29 µmol TE/g. A coefficient of variation of 46.98% suggests substantial differences in activity depending on the cultivation location.

The research findings indicates that the cultivation area has a significant impact on the variability of antiradical activity in Japanese quince fruit extracts. The strongest activity was identified in samples collected from the Vilnius region. These findings highlight the potential application of Japanese quince in the formulation of functional foods and dietary supplements due to its notable antioxidant-related properties.

Keywords: antioxidants, antiradical activity *in vitro*, growing area, Japanese quince, TFPH.

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Formation and Characterization of Whey Protein-Anthocyanin Complexes Obtained from Black Elderberry Juice: Binding Kinetics, Structural Interactions, Antioxidant Potential and Thermal Stability

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Abstract

The growing interest in naturally derived bioactive compounds has increased attention toward protein-polyphenol systems as promising ingredients for functional food and nutraceutical applications. In this study, complexes of whey proteins and anthocyanins extracted from black elderberry juice (*Sambucus nigra* L.) were developed and comprehensively characterized in order to evaluate their physicochemical interactions, antioxidant properties, and thermal resistance.

The binding process between whey proteins and elderberry anthocyanins was investigated by kinetic analysis and adsorption isotherm modeling, allowing the assessment of complex formation dynamics and the affinity of the protein matrix toward anthocyanin molecules. Structural changes and intermolecular interactions within the obtained complexes were analyzed using Fourier-transform infrared spectroscopy (FTIR) and Raman spectroscopy.

In addition, the antioxidant potential of the complexes was evaluated and compared with that of the non-complexed components, demonstrating that the protein-anthocyanin association may contribute to the preservation or enhancement of antioxidant activity. Particular attention was also paid to the thermal stability of the obtained systems. The results showed that complexation with whey proteins improved the resistance of anthocyanins to elevated temperature, suggesting a protective effect of the protein matrix against thermal degradation.

Overall, the findings confirm that whey proteins can serve as effective carriers for anthocyanins from black elderberry juice, forming stable complexes with favorable functional properties. Such systems may have considerable potential for the design of novel bioactive formulations with improved stability and antioxidant performance.

Keywords: whey proteins, anthocyanins, black elderberry juice, protein–polyphenol complexes, antioxidant activity, thermal stability.

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Efficient Red Phosphorescent OLEDs Enabled by Benzophenone–Carbazole Co-Host Materials

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Abstract

Organic light-emitting diodes (OLED) technology has rapidly evolved into sophisticated multilayer architectures that earned them a spot in commercial flat-panel displays and lighting applications [1-3]. In this work designed and synthesized four new benzophenone-(benzo)carbazole based host materials, namely BP-Cz2 (4,4′-Bis(9H-carbazol-9-yl)phenylmethanone), BP-BCz2 (bis(4-(11H-benzo[a]carbazol-11-yl)phenyl)methanone), BP-BCz ((4-(11H-benzo[a]carbazol-11-yl)phenyl)(phenyl)methanone) and BP-CzBCz ((4-(11H-benzo[a]carbazol-11-yl)phenyl)(4-(9H-carbazol-9-yl)phenyl)methanone).

All synthesized compounds exhibited excellent thermal stability and a strong tendency to form stable amorphous thin films, with glass transition temperatures exceeding 100 °C for most materials. Photophysical characterization revealed singlet energy levels ranging from 2.90 to 3.61 eV and triplet energy levels between 2.50 and 3.10 eV, corresponding to singlet–triplet energy gaps of 0.35–0.51 eV. These energy characteristics confirm that the benzophenone derivatives provide sufficient exciton confinement for red phosphorescent emitters. Furthermore, charge-transport measurements indicated hole and electron mobilities spanning from 10^{-3} to 10^{-12} $cm^2/(V \cdot s)$, highlighting the tunability of charge-transport properties through molecular design. The donor-acceptor compounds were evaluated as host materials in red OLED devices. Notably, devices employing a co-host configuration consistently outperformed their single-host counterparts. In particular, the BP-BCz-based co-host system utilizing OLED achieved a maximum external quantum efficiency of 17.9% with a reduced efficiency roll-off at high luminance.

Keywords: host material, glass transition temperature, amorphous layer, emitter, phosphorescent organic light emitting diode, efficiency.

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Supersaturated Complex of Bovine Lactoferrin– Does Its Therapeutic Potential Align with Its Safety Profile

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Abstract

Lactoferrin, classified as GRAS (Generally Recognized as Safe), has attracted substantial interest for several decades among clinicians, biotechnologists, and industry due to its high affinity for iron ions and its role in transporting iron from the intestine into the bloodstream [1]. This protein enables the absorption of bioavailable iron forms, a phenomenon particularly evident in newborns and infants, whose permeability facilitates iron uptake [2].

Recent discoveries regarding lactoferrin – specifically its capacity for supersaturation, allowing a markedly increased number of iron atoms to bind to a single protein molecule – raise important questions about the safety of such enriched variants. Current human intake guidelines for bovine lactoferrin depend on age and health status, ranging from 52 mg/kg body weight/day for adults (~3,4 g/day) to as much as 200mg/kg body weight/day for infants (~1.2 g/day) [3]. These recommendations, however, apply to conventional lactoferrin isolated from bovine milk, for which the saturation level has been reported as approximately 15%, equivalent to about 3 iron atoms per 10 protein molecules. In contrast, it has been shown that supersaturated lactoferrin complexes can be obtained, containing as many as 50 iron atoms per single lactoferrin molecule. [4].

In the study, we sought to determine whether iron-enriched lactoferrin complexes exhibits increased toxicity compared with its native, milk-derived counterpart. We evaluated this using an *in vitro* model, in which lactoferrin showed an LC70 value more than twofold higher than that of the complex in L929 cells (ATCC). The murine *in vivo* model (approved by the Local Ethics Committee for Animal Experiments in Katowice, approval no. 55/2025), in which mice received 10 mg LTF/mouse/day in the form of either native lactoferrin (0.21 mg Fe/g LTF) or the iron-enriched complex (7.5 mg Fe/g LTF), showed no evidence of increased toxicity. While cell-line experiments indicated a more pronounced toxic effect, these findings were not confirmed *in vivo*, presumably because exposure to the complex was higher *in vitro* than in mice. In mice, no behavioral or physiological abnormalities, no gross anatomical alterations in internal organs, no changes in hematological parameters, and no disturbances in tissue elemental composition were observed.

Keywords: lactoferrin, supersaturated complex of lactoferrin, GRAS protein, iron bioavailability, toxicity assessment, in vitro cytotoxicity, murine model, iron overload safety.

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Durable PVB-Based Nanocomposite Coatings: The Role of Surface Free Energy in Sustained, Multi-Functional Antimicrobial Efficacy

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Abstract

The escalating threat of antimicrobial resistance – projected to cause ten million deaths and US $1 trillion in healthcare costs by 2050 [1] – necessitates the urgent development of durable, long-lasting antimicrobial materials. This work evaluates the performance and aging characteristics of polyvinyl butyral (PVB)-based nanocomposite coatings incorporating silver nanoparticles (AgNPs), zinc oxide tetrapods (ZnO-Ts), and organic biocides (ampicillin, benzalkonium chloride, sodium pyrithione (NaPT), and triclosan). These scalable coatings are designed for frequently touched surfaces, including medical equipment, 3D-printed geometries, and industrial interfaces.

AgNP-PVB coatings, synthesized via UV-mediated photochemical processes [2], demonstrated exceptional long-term stability; UV-Vis-NIR and water contact angle measurements confirmed no significant degradation after two years, with sustained antiviral efficacy against SARS-CoV-2 RNA. In parallel, PVB-biocide coatings (specifically sodium pyrithione and triclosan) exhibited a unique "self-renewing" property, where mechanical abrasion removed superficial polymer layers to expose fresh biocide, increasing antibacterial efficacy against *E. coli* three-fold [3].

Further enhancement was achieved through synergistic PVB/ZnO-T/NaPT nanocomposites. The 3D tetrapod morphology [4] reinforces the polymer matrix mechanically while providing dual antimicrobial action via reactive oxygen species ROS generation and membrane depolarization. These composites achieved significant Log_{10} reductions of up to 5.91 against *S. aureus*, *P. aeruginosa*, and *C. albicans*, alongside an 87.7% reduction in biofilms.

Across all systems, Surface Free Energy (SFE) emerged as a critical predictor of antimicrobial behavior. In AgNP systems, higher hydrophobicity correlated with faster viral inactivation, while in PVB/ZnO-T/NaPT systems, smaller particle dimensions generated NaPT-induced hydrophilicity that improved broad-spectrum performance. This research demonstrates that the thoughtful modulation of SFE and nanocomposite morphology offers a robust pathway for engineering durable, self-renewing antimicrobial surfaces for high-risk environments.

Keywords: synergistic effect, antimicrobial activity, PVB nanocomposite.

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Effects of Natural and Chemical Additives on Alcohol Profile, Volatile Compounds, and Antioxidant Activity in Red Wine

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Abstract

Wine is one of the oldest alcoholic beverages, produced by fermenting fruit juice, most commonly grape juice, with yeast [1]. The leading wine-producing countries include Italy, France, Spain, the United States, and Chile, while high per capita consumption is observed in countries such as France, Portugal, and Slovenia [2]. Methanol is a naturally occurring compound in alcoholic beverages, formed mainly through pectin degradation, but it may also be present due to illegal addition [3-4]. Although similar to ethanol in taste and initial effects, methanol is highly toxic, as its metabolism produces harmful compounds such as formaldehyde and formic acid, which can cause severe health effects, including blindness and death [5]. Therefore, its concentration in beverages is strictly regulated. Thus, this study aims to evaluate the impact of natural and chemical agents on the formation of methanol, ethanol, and isoamyl alcohol in red wine, as well as on volatile compounds and antioxidant properties.

The red wine was produced under laboratory conditions from "Premium Merlot" grape must with varying amounts of additives such as bentonite, oak bark, and gallic and citric acids. The amount of methanol, ethanol and isoamyl alcohol were evaluated using GC-FID, while volatile compounds were analysed by GC-MS. Total phenolic and flavonoid content, as well as radical scavenging activity, were assessed by spectrophotometric methods.

Ethanol content ranged from 9.38% (bentonite) to 10.97% (citric acid 0.5 g/L), with increasing acid concentrations leading to reduced ethanol levels, likely due to inhibited yeast activity. Methanol content decreased with higher concentrations of citric and ascorbic acids, reaching the lowest value (0.123%) at 1.5 g/L citric acid, possibly due to inhibition of pectin-degrading enzymes. Oak bark increased isoamyl alcohol by ~10%, whereas bentonite and low gallic acid reduced it by ~5%. Several volatile compounds were identified, including ethyl 3-hexanoate and phenethyl alcohol. Antioxidant activity increased with citric and ascorbic acid concentration (up to 1.68 mg/mL). Oak bark enhanced phenolic (~20%) and flavonoid content (up to 0.132 mg/mL), while bentonite reduced phenolics (~13%) due to adsorption.

No clear overall trend was observed in the formation of ethanol, methanol, and isoamyl alcohol, as the effects of additives varied depending on type and concentration. Observed changes, such as reduced methanol with higher acid levels and increased isoamyl alcohol with oak bark, were not consistent across all samples. These variations may be influenced not only by the additives but also by the composition of the fermenting grape must, which affects yeast activity and metabolite formation.

Keywords: methanol, ethanol, isoamyl alcohol, wine.

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Physiological and Biochemical Responses of *Betula pendula* To Heavy Metal Stress

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Abstract

Heavy metal pollution poses a significant environmental threat due to its persistence, toxicity, and capacity to accumulate in plant tissues, which can disrupt growth and metabolism [1-2]. Prior research has demonstrated that exposure to metals such as cadmium (Cd), lead (Pb), and arsenic (As) causes oxidative stress in plants by producing reactive oxygen species, which can damage cellular structures and impair physiological functions [3-4]. In response, plants activate defense systems, including the buildup of secondary metabolites such as phenolics and flavonoids, which are crucial for stress mitigation and adaptation [5-6].

In this study, the response of *Betula pendula* to Cd, Pb, and As exposure was evaluated under hydroponic conditions, focusing on growth parameters and biochemical stress indicators. The results showed statistically significant treatment effects across all measured variables, indicating a coordinated physiological response rather than isolated changes. Growth inhibition was most pronounced at higher Cd and Pb concentrations, especially in roots, suggesting strong metal accumulation and limited translocation. Cadmium exposure triggered a typical oxidative stress response, evidenced by increased malondialdehyde (MDA) levels and changes in photosynthetic pigments and secondary metabolites, indicating membrane damage as a primary toxicity mechanism. Arsenic effects were concentration-dependent, with moderate doses stimulating pigment and metabolite accumulation, suggesting adaptive metabolic adjustments. Lead exhibited a biphasic response, where moderate concentrations maintained or slightly improved metabolic activity, while higher levels caused suppression. Across treatments, increased levels of soluble sugars, total phenolics (TPC), and flavonoids (TFC) were observed, supporting their role in stress mitigation and antioxidant defense. Pigment reduction at higher Cd and As concentrations indicated impairment of the photosynthetic apparatus under severe stress. Overall, *Betula pendula* exhibits metabolic flexibility but structural sensitivity under heavy metal exposure, with oxidative stress serving as a central response mechanism and dose-dependent effects influencing the overall physiological outcome.

These findings highlight the importance of managing oxidative stress and secondary metabolite responses in *Betula pendula* exposed to heavy metals. Future research should focus on uncovering the underlying molecular mechanisms and assessing the species' potential for phytoremediation in contaminated environments.

Keywords: *Betula pendula*, heavy metals, cadmium, lead, arsenic, oxidative stress, phenolics, flavonoids.

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Evaluation of Phenolic Compound Content and Antioxidant Activity of *Viburnum Opulus* L. 'Leningradskaja Otbornaja' Leaves During Vegetation

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Abstract

Viburnum opulus L. is a valuable, ornamental and medicinal plant belonging to the *Viburnum* genus of the Viburnaceae Raf. family [4]. The *Viburnum* genus consists of more than 230 species of evergreen, semi-evergreen and deciduous shrubs and small trees [4]. *Viburnum opulus* is widespread in Europe, North America and North Asia. For medicinal purposes, all parts of *Viburnum opulus* are used – the fruits, fruit juice, bark, and leaves – due to their rich chemical composition [3]. The leaves of the *Viburnum opulus* L. species are responsible for various medicinal properties of these plants, such as diuretic, cardiovascular stimulating, uterine calming, antimicrobial, anti-inflammatory, and antispasmodic [1, 2]. Leaves of *Viburnum opulus* L., based on their biochemical composition, can be considered an equally valuable raw material, as they contain organic substances, such as sugars, ascorbic acid, pectic substances, alkaloids, tannins, phenolic acids, and higher fatty acids [3]. *Viburnum opulus* L. ('Leningradskaja Otbornaja') leaves collected in 2023, from Vytautas Magnus University Kaunas Botanical Garden, Pomology Science Sector, during plant vegetation. Extracts were prepared using 0.2 g of dry matter and 20 mL of 70% ethanol. The total phenolic content was determined using the Folin-Ciocalteu assay and antioxidant activity – ABTS (radical scavenging activity) and FRAP (reducing activity) assays using a spectrophotometer. The results showed that the amount of phenolic compounds of the 'Leningradskaja Otbornaja' leaves samples varied from 26.35 mg GRE/g (SD=0.67 mg GRE/g) to 54.86 mg GRE/g (SD=1.09 mg GRE/g) ($P<0.05$). The lowest concentration of phenolic compounds was determined at the end of leaf fall, at 26.35 mg GRE/g (SD=0.67 mg GRE/g). The highest concentration was determined during mass flowering, respectively 54.86 mg GRE/g (SD=1.09 mg GRE/g). The radical scavenging of the 'Leningradskaja Otbornaja' varied from 488.91 mg GRE/g (SD=32.66 mg GRE/g) to 990.64 mg GRE/g (SD=36.11 mg GRE/g) ($p<0.05$). The lowest radical-scavenging activity was determined at the beginning of flowering, at 488.91 mg GRE/g (SD=32.66 mg GRE/g). The highest radical-scavenging activity was observed during mass leaf fall, at 990.64 mg GRE/g (SD=36.11 mg GRE/g). Determined reducing activity of the leaf samples ranged from 423.24 mg GRE/g (SD=40.23 mg GRE/g) to 1898.56 mg GRE/g (SD=40.19 mg GRE/g) ($p<0.05$). The lowest reducing activity was found during leaf colour change, at 423.24 mg GRE/g (SD = 40.23 mg GRE/g). The highest reducing activity was determined at the end of leaf fall, respectively 1898.56 mg GRE/g (SD=40.19 mg GRE/g). The results suggest that the highest therapeutic potential of *Viburnum opulus* L. 'Leningradskaja Otbornaja' leaves is achieved during mass flowering (end of May) and leaf fall (in August and September).

Keywords: antioxidant activity, leaves, Leningradskaja Otbornaja, phenolic compounds, *Viburnum opulus*.

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Novel PH-Responsive Poly(2-Oxazoline) Lipid Nanocapsules with Imidazole for Enhanced Photodynamic Antitumor Activity

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Abstract

Efficient delivery of hydrophobic photosensitizers to tumour tissue remains a major challenge in light-activated cancer therapy. The limitations of PEG-based nanocarriers, such as instability, immunogenicity and restricted functionalisation, have encouraged the development of alternative platforms. The introduction of imidazole enhances the pH-responsiveness of poly(2-oxazoline) lipid nanocapsules (POx-LNCs), which could improve their ability to enter cells. This study evaluated the cytotoxicity and photodynamic anti-tumour efficacy of POx-LNCs and imidazole-modified 1S-PDI-Ph-loaded POx-LNCs (1S-PDI-Ph@POx-LNCs-Im) upon light activation.

B16F10 melanoma cells were treated with POx-LNCs or 1S-PDI-Ph@POx-LNCs-Im (1×10^7–1×10^{12} NP/mL for 24 h) and cell viability was assessed using a resazurin assay. Photocytotoxicity was then measured following 530 nm LED irradiation (160 mW/cm^2, 10 minutes). Reactive oxygen species (ROS) formation was visualised by confocal microscopy following staining with H_2DCFDA and Hoechst 33342. Nanocapsule uptake and FRET were analysed by flow cytometry following an incubation period of 2–24 hours with DiI/DiD-labelled POx-LNCs.

A concentration of 1×10^{10} NP/mL was identified as non-toxic, whereas higher doses resulted in significant cytotoxicity. Without irradiation, empty POx-LNCs had no effect on cell viability, whereas POx-LNCs-Im reduced viability to 87.40 ± 4.97%. However, upon LED illumination, 1S-PDI-Ph@POx-LNCs-Im induced strong photocytotoxicity, reducing cell viability to 18.1 ± 2.8%. This is in clear contrast to the negligible effects observed with empty nanocapsules. Flow cytometry further demonstrated enhanced uptake of imidazole-modified nanocapsules, reflected by higher median FRET intensity (11,616.5 versus 7,513.4 for non-imidazole LNCs). Confocal microscopy confirmed robust ROS production in cells treated with illuminated 1S-PDI-Ph@POx-LNCs-Im.

Including imidazole significantly improved the intracellular delivery and photodynamic performance of POx-LNCs. Enhanced uptake was associated with higher FRET intensity and greater ROS-mediated cytotoxicity. The superior photocytotoxic response of 1S-PDI-Ph@POx-LNCs-Im compared to the non-imidazole system shows that imidazole helps with both the internalisation of nanoparticles and the activation of photosensitisers within a tumour-mimicking environment. These findings reinforce the value of imidazole modification as a strategy for optimising POx-based nanocarriers for photodynamic therapy.

Imidazole-modified POx-LNCs substantially enhance the cellular uptake and photodynamic anti-tumour activity of 1S-PDI-Ph. This positions 1S-PDI-Ph@POx-LNCs-Im as a promising platform for improving photodynamic cancer therapy.

Keywords: lipid nanocapsules, poly(2-oxazoline), imidazole, photodynamic therapy, 1S-PDI.

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Formulation and Biopharmaceutical Evaluation of Oleogels with Naftifine HCl

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Abstract

Topical delivery of lipophilic antifungal agents remains challenging because conventional semi-solid dosage forms may provide limited drug release and insufficient penetration through the *stratum corneum* [1]. Oleogels represent a promising alternative, as their physicochemical and release properties can be modified by the selection of gelator and oil phase [2]. This study aimed to develop Oleogel formulations containing 1% Naftifine HCl and to evaluate their physicochemical characteristics, biopharmaceutical performance, and stability. Six oleogel formulations were prepared using Span 60 or Aerosil in combination with different Oil-phase compositions. The formulations were evaluated for pH and viscosity, while *in vitro* release was assessed using modified Franz diffusion cells and *ex vivo* penetration studies were performed using human skin. Quantitative determination of Naftifine HCl was carried out by validated UPLC. Stability was assessed by freeze–thaw cycles, centrifugation, and long-term stability testing. The prepared Oleogels showed pH values in the range of 4.89-5.92. Their performance depended on both gelator type and Oil-phase composition. Aerosil-based systems demonstrated more sustained *in vitro* release, whereas formulations containing vegetable Oils showed earlier release. Formulation composition had a statistically significant effect on both *in vitro* release and *ex vivo* skin penetration *($p < 0.05$)*. The most pronounced drug distribution within the skin was observed for the Aerosil formulation containing Mineral oil and Sunflower oil, while Aerosil-based oleogels also demonstrated better overall stability than Span 60-based systems. After six months of long-term stability testing, no significant changes in the *in vitro* release kinetics were observed. Taken together, these findings indicate that the Aerosil formulation containing Mineral oil and Sunflower oil was the most promising Oleogel system for further development as a topical Naftifine HCl delivery platform.

Keywords: Oleogels, Naftifine HCl, topical delivery, *in vitro* release, *ex vivo* penetration, stability.

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The Influence of Phospholipid Profile and Fatty Acid Composition on the Physicochemical Parameters of Natural Emulsion Systems

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Abstract

Cosmetic product engineering is increasingly shifting toward replacing synthetic surfactants with natural alternatives, adhering to the principles of "Green Chemistry." However, maintaining the kinetic stability of systems characterized by a high dispersed phase content remains a significant challenge. The objective of this study was to evaluate how the emulsifiers of natural origin - specifically various types of lecithins - affects their capacity to stabilize high-lipid cosmetic emulsions.

The research focused on lecithins derived from diverse sources: soybean, sunflower, and hen egg yolk. To precisely characterize their molecular architecture, the following analyses were conducted:

- Profiling of phospholipid classes (PC, PE, PI, PA) using high-performance liquid chromatography coupled with mass spectrometry (HPLC-MS).
- Fatty acid profiling via gas chromatography with flame ionization detection (GC-FID).

The emulsifying properties were assessed within model cosmetic formulations by monitoring their temporal stability and characterizing their microstructure through fluorescence microscopy.

The results revealed substantial variations in the chemical composition of the analyzed lecithins, which directly influenced their interfacial behavior. It was demonstrated that the ratio of saturated to unsaturated fatty acids, along with the distribution of specific phospholipid fractions, determines the resistance of the emulsion to coalescence and phase separation. Fluorescence analysis confirmed that the strategic selection of a lecithin source enables the formulation of stable, biocompatible systems without the requirement for synthetic co-emulsifiers.

Keywords: lecithins, green chemistry, cosmetic emulsions.

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Modulatory Effects of Calcium Electroporation and H-FIRE Waveforms on H9c2 Cell Viability and Membrane Permeabilization

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Abstract

Electroporation-based technologies, particularly Pulsed Field Ablation (PFA), are rapidly becoming the gold standard for treating cardiac arrhythmias [1]. However, the precise electrical thresholds required to induce reversible electroporation (RE) and irreversible electroporation (IRE) in cardiac tissue remain a subject of ongoing investigation [2]. This study aims to characterize the sensitivity of H9c2 cardiac myoblasts to a range of pulse parameters, comparing monopolar pulses with High-Frequency Irreversible Electroporation (H-FIRE) and evaluating the additive effects of Calcium Electroporation (Ca-EP).

H9c2 cells were exposed to electric fields in two distinct states: in suspension and as adherent confluent monolayers. Pulse protocols included conventional monopolar pulses (100 µs, 200-3600 V/cm) and H-FIRE bipolar bursts (1000-3600 V/cm microsecond range bipolar pulses interspaced with microsecond range gaps, delivered in bursts interspaced by 1 s) to investigate the more clinically relevant treatment conditions. Membrane permeabilization post-EP was assessed using fluorescent dye propidium iodide, immediately after pulse delivery for RE and 20 min later for IRE determination, while long-term cell viability (24-hour post-treatment) was evaluated via MTS-PMS colorimetric assay for suspension electroporation and Calcein-AM staining for monolayer culture conditions. Furthermore, the cytotoxicity of intracellular calcium delivery via electroporation was mapped under both conventional electroporation and H-FIRE conditions.

Current findings in suspension cultures indicate a RE threshold for significant PI delivery at 800 V/cm, with similar threshold for detectable IRE. Notably, the pulse strength required for cell ablation in monolayer culture conditions are noticeably lower, likely due to differences in cell geometry and substrate attachment. The transition to H-FIRE waveforms resulted in a significant shift of IRE thresholds and a change in IRE/RE ratio in monolayer setting. Additionally, H9c2 cell culture was shown to exhibit an increase in resilience against CaEP when compared to other commonly employed cell cultures in both suspension and monolayer states, and an antagonistic effect of 2 mM Ca^{2+} delivery for IRE ablation.

Keywords: pulsed field ablation, electroporation, irreversible electroporation, calcium electroporation.

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Controlled Environment Agriculture for High-Value Pharmaceutical Crop in Vertical Farms

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Abstract

Growing interest in high value pharmaceutical crops of standardized quality allows and encourages to seek for more modern and efficient approach to new cultivation methods. One of them is controlled environment agriculture CEA that can offer consumers sustainable, resilient, clean, value-added pharmaceutical crops. Growing crops in CEA could help customers get high-quality plants for production of pharmaceutical substances. According to Dsouza et al. (2024) constant and controllable cultivation conditions allow to cultivate plant material the whole year, obtain predictable and planned yields, and, the most important, have uniform and standardized phytochemical quality. Moreover, CEA can help control expenses, consumers for example, can set optimal lighting intensities and save money on electricity comparing to conventional cultivation methods [1]. In this study our aim is to evaluate the cultivation potential of well-known *Leonurus sp.* medicinal plants. These plants that are renowned for medical purposes like gynecological conditions, strong neuroprotective effects and improving blood circulation were cultivated in controlled conditions for higher antioxidant value. *Leonurus* plants accumulate medically active compounds leonurine, housuine and flavonoids including quercetin, luteolin, rutin [2]. Two *Leonurus* species belonging to *Lamiaceae* family, *Leonurus cardiaca* and *Leonurus sibiricus,* were used in this study. Plants were cultivated under equal conditions. Seedlings, planted in plastic growing cubes, made from blend of peat, moss and vermiculite, were transferred to deep water culture hydroponic systems in a model CEA chamber at 21/17 °C day/night (16 h photoperiod). Light source - light emitting diode (LED), lighting was created, consisting of 21.6% blue (455 nm), 65% red (660 nm) and 13.4% far-red (740 nm) light at three different light intensities of 150 µmol m-2 s-1, 300 µmol/(m^2·s) and 450 µmol/(m^2·s). Plant material was collected at two growth stages: vegetative branching stage and generative butonisation stage. At the end of each growing cycle morphological traits, total phenol content and antioxidant activity were measured. Antioxidant activity was measured using DPPH, FRAP and ABTS methods. The results disclose significant differences in antioxidant properties between the two Leonurus species, two growth stages, plant organs, as well as the lighting intensity, which has a pronounced impact on plant growth and antioxidant response.

Keywords: medical, growth, light emitting diodes, antioxidant activity.

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Coriolus versicolor Extracts Restore Macrophage Responsiveness by Reversing Endotoxin Tolerance in RAW264.7 Cells

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Abstract

Endotoxin tolerance is a phenomenon in which immune cells, after prolonged or repeated exposure to lipopolysaccharide (LPS), develop reduced responsiveness to subsequent pro-inflammatory stimuli. This impaired ability to mount a pro-inflammatory response is characterized by decreased cytokine production, alterations in receptor composition, and changes in cellular physiology. On one hand, endotoxin tolerance serves as a protective mechanism against endotoxin-induced toxicity by preventing excessive immune activation. On the other hand, it promotes the development of an immunosuppressive environment, which may contribute to the progression of various diseases an immunosuppressive background, including cancer [1]. *Coriolus versicolor* (CV) is a well-known medicinal fungus widely used in traditional medicine, particularly in Asian countries. It has been reported to possess immunomodulatory, anticancer, antioxidant, and antibacterial properties. Previous studies conducted in our department indicate the potential of CV extract to modulate endotoxin tolerance [2]. Additionally these results are consistent with literature demonstrating that β-glucans, which are abundant in CV extract, can restore immune responsiveness under endotoxin-tolerant conditions [3][4]. The aim of this study was to determine whether CV extract is capable of restoring the pro-inflammatory response in RAW264.7 macrophages under endotoxin tolerance (ET) conditions. To achieve this, an ET model was established in which macrophages were stimulated with two doses of 100 ng/ml LPS administered at 24-hour intervals, followed by restimulation after 1, 6, or 24 hours. The applied model did not demonstrate significant cytotoxic effects on cell viability. The expression of pro-inflammatory cytokines, tumor necrosis factor alpha (TNF-α) and interleukin-6 (IL-6), was significantly increased in cells stimulated with a single dose of LPS, whereas stimulation with a second dose resulted in a marked decrease in cytokine production, indicating the development of ET. To reverse ET, macrophages were allowed to recover for 48 hours and were subsequently restimulated for 6 hours with either another dose of LPS or 200 ng/ml CV extract. Restimulation with CV extract restored the production of the aforementioned pro-inflammatory cytokines to levels comparable to those observed in naïve cells treated with the same compound, without inducing cytotoxic effects in endotoxin-tolerant cells.. These findings suggest that CV extract may restore immune responsiveness and reverse ET. These findings open new perspectives for the potential application of CV extract in studies aimed at developing novel therapeutic strategies for diseases associated with immunosuppression.

Keywords: endotoxin tolerance. *Coriolus versicolor*, lipopolysaccharide, immunomodulation.

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Genetic Diversity of Lithuanian Populations of *Impatiens glandulifera* Royle

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Abstract

Himalayan balsam (*Impatiens glandulifera* Royale) from the *Balsaminaceae* family is considered one of the most widely distributed invasive non-native plant species in Europe [1]. *Impatiens glandulifera* is an annual plant that has become widespread in riverbanks throughout Europe. Its success is largely attributed to its strong competitive ability, including efficient use of resources and allelopathy—the release of chemicals that can inhibit the growth of surrounding plants [2]. The chloroplast is a vital organelle responsible for photosynthesis and energy production in green plant cells [3]. Owing to its relatively small genome, conserved structure, low mutation rate, and haploid nature, cpDNA is widely used in studies of diversity at lower taxonomic levels [4]. As chloroplast DNA is maternally inherited, it serves as an important resource for molecular marker development, and phylogenetic research [5]. DNA barcoding applications include sequencing chloroplast markers [6]. There are studies done on different *Impatiens* species chloroplast genome all over the world [7, 8]. A substantial number of studies have investigated the chloroplast genome of *Impatiens glandulifera* in Europe, particularly in the context of its status as an invasive species and its evolutionary and ecological dynamics [9, 10]. In this study, cpDNA markers were investigated and sequenced from several populations in Lithuania. Sampling sites included various geographic parts of Lithuania. Sequence analysis were performed using MEGA and GenBank resources, applying the Maximum Likelihood approach and the Tamura–Nei substitution model [11]. No polymorphism was detected among individuals within or between Lithuanian populations. Chloroplast DNA markers from Lithuanian populations were compared using GenBank reference sequences to assess polymorphism between Lithuanian samples and those from other countries.

Keywords: invasive species, chloroplast DNA markers.

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Statistical and Technical Analysis for Human Activity Recognition Using Smartphones

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Abstract

The widespread adoption of smartphones equipped with advanced inertial sensors, including accelerometers and gyroscopes, has significantly accelerated the development of Human Activity Recognition (HAR) systems, which play a critical role in healthcare monitoring, elderly care, and fitness tracking applications. Despite these advancements, achieving an optimal balance between computational efficiency and high classification accuracy remains a key challenge. In this study, the publicly available HAR70+ dataset was utilized, comprising tri-axial motion sensor data collected from 18 older adults aged between 70 and 95 years. The analysis and model implementation were conducted using Python within the Google Colab environment, employing widely used libraries such as Scikit-learn, TensorFlow, and Keras. A comprehensive set of machine learning (ML) and deep learning (DL) models, including Support Vector Machines (SVM), K-Nearest Neighbours (KNN), Long Short-Term Memory (LSTM) networks, and Convolutional Neural Networks (CNN), were developed and evaluated. Data preprocessing techniques, particularly noise reduction and StandardAero normalization, substantially improved data quality and model performance. The results indicated that the KNN model achieved the highest classification accuracy of 95.74%, demonstrating strong effectiveness in identifying primary activity classes, followed closely by the CNN model with an accuracy of 94.95%. Furthermore, the application of Principal Component Analysis (PCA) enabled a reduction of approximately 30% in computational time with minimal impact on classification accuracy. Overall, the integration of rigorous statistical preprocessing with advanced ML and DL techniques provides a robust and efficient framework for smartphone-based HAR systems. While KNN exhibited superior performance for this specific dataset, deep learning models such as CNN and LSTM offer greater scalability and adaptability for complex and real-time applications. This study ultimately aims to statistically analyze sensor-derived data to extract behavioral insights, develop and evaluate diverse classification models, and compare preprocessing and modeling strategies to establish a reliable and scalable HAR framework.

Keywords: Human Activity Recognition (HAR), smartphone sensors, accelerometer, gyroscope, machine learning, deep learning, KNN, CNN, LSTM, SVM, preprocessing, PCA, elderly monitoring, wearable technology, classification accuracy.

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Changes in Some Chlorophyll Fluorescence Indices of Barley due to Exposure to Millimeter-sized PET Particles

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Abstract

The accumulation of plastic particles in soil environments has increased concern, particularly due to their potential impact on plant physiological processes. This study underscores the effects of millimetre-sized Polyethylene Terephthalate (PET) particles, most used as packaging material, on the photosynthetic performances of *Hordeum Vulgare* (Barley) by chlorophyll fluorescence analysis. Barley was grown under controlled environmental conditions while exposing it to PET particles (1-5mm) at a concentration of 1%, 3%, 5% (w/w) for 40 days. Key fluorescence parameters such as maximum quantum efficiency of photosystem II (Fv/Fm), performance index (PI abs), primary photochemistry efficiency φ(Po), electron transport probability ψ(Eo), and electron transport flux leading to the reduction of the PSI end acceptor per active PS II RC (RE0 /RC) were analysed. Statistical analyses, including ANOVA followed by LSD post-hoc testing at $\alpha = 0.05$, were performed.

The results showed that Fv/Fm and φ(Po) remained statistically insignificant across all treatments, explaining that the maximum efficiency of PS II photochemistry was not affected by PET exposure. RE0/RC also showed a decreasing trend of up to ~21%; however, this change was not statistically significant. In contrast, PI abs decreased significantly across all PET-treated groups with reductions of approximately 19%, 23%, and 27% under 1%, 3%, and 5% PET treatments, respectively, as compared to the control. Likewise, ψ(Eo) also showed a significant decline of approximately 8-12% with increasing PET concentration. These results indicate a progressive limitation in overall photosynthetic performance and electron transport efficiency beyond the primary quinone acceptor (QA).

Overall, the findings demonstrate that while PET particles do not impair the core photochemical efficiency of PS II, they significantly reduce the functional performance of photosynthetic machinery in barley. These dose-dependent reductions in performance-related parameters explain the sensitivity of chlorophyll fluorescence analysis in detecting early physiological responses to plastic particle exposure.

Keywords: barley (*Hordeum vulgare),* PET particles, chlorophyll fluorescence, Photosystem II, electron transport.

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Functionalized *p*-Phenylenediamines as Efficient Hole-Transporting Materials for Optoelectronic Applications

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Abstract

Organic light-emitting diodes (OLEDs) are widely utilized in display and solid-state lighting applications because of their high efficiency, flexibility, and low-cost manufacturing [1]. One of the key components of OLEDs is the hole-transporting layer, which is responsible for efficient hole injection from anode into the organic layer and subsequent transport to the emissive layer. Compared to their inorganic counterparts, organic hole-transporting materials (HTMs) offer several advantages, including lower cost, superior film-forming properties, and environmental compatibility [2]. Therefore, the design of new HTMs with high thermal and morphological stability of their layers is still a critical goal for the advancement of OLED performance. In this work, we report on the synthesis and characterization of new carbazolyl- and dibenzofuranyl-functionalized p-phenylenediamine derivatives as potential HTMs. The target compounds were synthesized in good yields via the Buchwald–Hartwig cross-coupling reaction between functionalized p-phenylenediamine derivatives and the corresponding carbazole or dibenzofuran derivatives. The study of photophysical properties revealed that the compounds exhibit room-temperature phosphorescence when molecularly dispersed in an inert polymer matrix, along with excellent thermal stability. Their 5% mass loss temperatures exceed 400 °C. The compounds form molecular glasses with glass transition temperatures above 100 °C. The ionization energies of the compounds, estimated by photoelectron emission spectroscopy, were found to range from 5.02 to 5.29 eV. The hole mobilities, determined by the space-charge-limited current method, ranged from 5.69×10^{-5} to 2.34×10^{-4} cm²/(V·s). Taking into account their relatively low ionization energies and high hole mobilities, the synthesized derivatives of carbazolyl- and dibenzofuranyl-functionalized p-phenylenediamine show strong potential for application not only as HTMs in OLEDs, but also in perovskite solar cells.

Keywords: p-phenylenediamine, OLED, hole-transporting material.

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Influence of Different Processing Methods on Bee Pollen Phytochemical Composition

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Abstract

Bee pollen (BP) is a result of agglutination of plant pollen, nectar and salivary enzymes of bee origin. This natural product contains a broad range of bioactive compounds, including amino acids and vitamins, particularly those of the B – group and vitamin C. Processing temperature may alter the chemical composition of bee pollen, highlighting the importance of evaluating the effects of drying and freezing on its stability. The aim of this study was to evaluate the influence of different preservation methods on the phytochemical composition of bee pollen.

The BP samples used in this study originated from an apiary in Talkoniai, Pasvalys district, Lithuania. BP was divided into two portions, one of which was dried at +28 °C on day 1 and at +35 °C on day 2 and placed at room temperature (20 ± 5 °C) in a dark place for several days before use. The remaining portion was frozen at −20 °C, and −80 °C. Aqueous extracts were prepared. The amino acid and B-group vitamin content was evaluated in aqueous extracts using UHPLC–ESI-MS/MS method. The ascorbic acid content was determined using a titrimetric method.

Extracts from dried BP exhibited a total free amino acid content of 267.97 ± 14.60 µg/g DW, frozen samples 256.58 ± 11.92 µg/g DW at −20 °C and 243.82 ± 15.60 µg/g DW at −80 °C, $p > 0.05$. 16 free amino acids were identified in all samples of which proline was the most abundant under all preservation methods, with concentrations of 66.35 ± 1.78 µg/g DW in dried samples, 68.14 ± 2.20 µg/g DW in samples frozen at −20 °C, and 63.22 ± 4.44 µg/g DW in samples frozen at −80 °C. Tyrosine exhibited the lowest levels, with concentrations of 1.02 ± 0.19 µg/g DW in dried samples, 1.08 ± 0.31 µg/g DW in samples frozen at −20 °C, and 0.85 ± 0.14 µg/g DW in samples frozen at −80 °C. Among the identified B-group vitamins (B1, B2, B3, B5, B6), pantothenic acid (B5) was the most abundant in both dried and frozen BP, with concentrations ranging from 2.63 to 3.24 µg/g DW. Lower concentrations were observed for thiamine (B1) (2.35–2.49 µg/g DW) and nicotinamide (B3) (0.81–2.29 µg/g DW), whereas riboflavin (B2) was present in the smallest amounts, varying between 0.26 and 0.73 µg/g DW. Ascorbic acid content was 1.49 ± 0.06 mg/g at −80 °C, 0.87 ± 0.06 mg/g at −20 °C, and 0.21 ± 0.00 mg/g in dried samples, $p < 0.05$.

Results indicated that aqueous extracts from dried bee pollen contained somewhat greater amounts of free amino acids compared with fresh - frozen ones, with the lowest value at -80 °C. Pantothenic acid was present at the highest concentrations among the B-group vitamins, followed by thiamine and nicotinamide, whereas riboflavin was detected at the lowest concentrations. As for ascorbic acid, freezing preserved higher amounts compared to drying, with the highest concentration observed in samples frozen at −80 °C.

Keywords: bee pollen, free amino acids, B-vitamins, ascorbic acid.

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Genetic Diversity of *Anthemis trotzkiana* Claus Populations in Kazakhstan

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Abstract

Anthemis trotzkiana Claus is a rare endemic species distributed in Western Kazakhstan and other isolated areas characterized by chalk and limestone outcrops. Because of its narrow distribution, the assessment of genetic diversity in this species is important for conservation and for understanding its evolutionary relationships.

The aim of this study was to evaluate the genetic diversity and structure of *A. trotzkiana* populations in Kazakhstan using chloroplast DNA markers and to assess its relationship with related species of the family Asteraceae. Discordant phylogenetic signal between plastid genome regions and nuclear DNA ITS has been shown to reveal complex evolutionary histories within *Anthemis*, such as allopolyploid origin [1]. Plant material was collected from three populations in Kazakhstan. Standard molecular methods were applied, including DNA extraction, polymerase chain reaction, agarose gel electrophoresis, DNA sequencing, and phylogenetic analysis. Several chloroplast DNA regions were analyzed.

The results showed that genetic variation in *A. trotzkiana* was detected only in the *rps16* and *rpl32–trnL* regions, *psbA–trnH* and *trnG* regions were conserved in all analyzed individuals. Based on the combined chloroplast DNA data, five haplotypes were identified. The highest genetic diversity was observed in the Ishkaragantau population, while the Bestau population showed the lowest variation. The detected polymorphisms were represented by single nucleotide substitutions, insertions and deletions in variable chloroplast regions. Phylogenetic analysis revealed that *A. trotzkiana* is closely related to species of the genus *Tanacetum*, supporting a close evolutionary relationship within Anthemideae. The obtained results expand current knowledge on the genetic structure of this rare endemic species and provide a molecular basis for further phylogeographic and conservation studies of *A. trotzkiana* in Kazakhstan. Genome-wide comparisons indicate that only a limited set of chloroplast loci is highly informative at low taxonomic levels, with regions such as *rpl32–trnL* and *trnH–psbA* among the most variable [2].

Keywords: *Anthemis trotzkiana*, chloroplast DNA, phylogenetic analysis, populations.

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Evaluation of Combined Electroporation, Chemotherapy, and Immunotherapy in a Triple-Negative Breast Cancer Murine Model

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Abstract

Despite significant therapeutic progress, the development of protocols that maximize tumour regression without compromising systemic safety continues to be a critical unmet need in cancer treatment. This study evaluates a multi-modal therapeutic strategy combining pulsed electric fields (Irreversible Electroporation (IRE) and reversible Electroporation (EP)) with chemotherapy and immunotherapy (programmed cell death protein 1 (PD-1) blockade). The aim was to determine whether integrating these triggers for localized tumour ablation and enhanced drug delivery could achieve improved tumour suppression while maintaining the highest possible survival rate. In this experiment, a triple-negative breast cancer model was established using female BALB/c mice. Each mouse was administered a single subcutaneous injection of 100 µL containing $2 \cdot 10^6$ 4T1 cells. Once tumours reached the target volume, mice were randomized into experimental groups, including monotherapies and various combinations. Electroporation was performed using eight 99 µs pulses at 1 Hz, with field strengths of 2.8 kV/cm for IRE and 1.5 kV/cm for EP. Mice in the chemotherapy groups received a single 0.088 mg intravenous dose of cisplatin (1 mg/mL), whereas the immunotherapy groups were administered anti-PD-1 monoclonal antibody 0.2 mg (10 mg/mL) intraperitoneally every two days for a total of four injections. Results demonstrated that all therapeutic interventions significantly inhibited tumour growth compared to the control (537.30 ± 67.0 mm^3).

The greatest reduction was observed in the triple-combination group (electroporation + chemotherapy + immunotherapy), which achieved a 55.2% reduction in tumour volume, resulting in the lowest final volume of 240.56 ± 40.12 mm^3. Notably, while most groups maintained a 100% survival rate, mortality was exclusively observed in mice that were treated with IRE. Survival decreasing to 80% in the IRE monotherapy and 85.71% in the anti-PD-1 + IRE group. These findings suggest that the triple combination of immune checkpoint inhibition, platinum-based chemotherapy, and reversible electroporation offers the optimal balance between maximum anti-tumour efficacy and systemic safety.

Keywords: electroporation, chemotherapy, immunotherapy, breast cancer, tumour model *in vivo*.

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Carbazole-Benzocarbazole Fragments Having Derivative as Very Efficient Host Material for TADF Based OLEDs

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Abstract

Organic light-emitting diodes (OLEDs) are widely adopted in modern display and lighting technologies; however, while significant progress has been achieved in the development of thermally activated delayed fluorescence (TADF) emitters, comparatively limited attention has been paid to the rational design of compatible host materials. In this work, a carbazole–benzocarbazole-based derivative, BCCOX, was designed and synthesized as an efficient host material for green TADF OLEDs. BCCOX maintains excellent thermal integrity, exhibiting a decomposition onset beyond 400 °C and a high glass transition temperature of approximately 194 °C, ensuring morphological integrity and operational reliability under device fabrication and operating conditions. The material further possesses a wide optical bandgap of 3.6 eV and favorable exciton dynamics, enabling effective exciton confinement and utilization in TADF systems. When employed as the host matrix in green TADF OLED devices, BCCOX delivers a maximum external quantum efficiency of 10.4%, along with a current efficiency of 20.6 cd/A and a power efficiency of 12.7 lm/W at relatively low driving voltages. These results demonstrate that carbazole–benzocarbazole architectures offer a robust and versatile platform for high-performance host materials, positioning BCCOX as a promising candidate for efficient, stable, and cost-effective next-generation OLED display applications.

Keywords: Carbazole–benzocarbazole compounds; green TADF; glass transition temperature; thermal stability; solution process OLED.

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Varietal Effects on the Quality and Rheological, Physical Properties of Oat Milk

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Abstract

Oats (*Avena sativa L.*) are a major cereal grain grown and consumed in Lithuania. With its favorable climatic conditions, Lithuania is one of the Baltic countries where oats have been historically cultivated and integrated into the local diet. There has been a recent increase in interest in oats, because oats are a plant with phytosanitary properties and the cultivation of oats in Lithuania plays an important role in crop rotation systems and soil conservation, as oats are a hardy crop that requires relatively low inputs compared to other cereals [1]. Studies generally show little difference in the elemental composition of grains when organic and conventional production are compared in the same environment, on the same soil, using the same genotype [2]. Different oat varieties may vary in their composition, impacting the nutritional profile, sensory attributes, and functional properties of the resulting oat milk [3]. The recent study showed that, the stability and sensory quality of oat milk might be closely associated with the protein and starch content of oat kernels [4].

The aim of this study was to investigate the influence of Lithuanian oat variety on the properties of oat milk. Oat milk was prepared from 2 organic oat cultivars and 2 conventional oat cultivars. Samples were taken for analysis after 1, 2 and 7 days of cold storage. The dry matter, turbidity, color, pH, milk stability and viscosity were determined.

Regarding the impact of oat variety on the oat milk properties were found correlations between cultivars and rheological and physical properties of milk. Stability decreased (from 80.95 % to 52 %) and turbidity increased (from 12.9 NTU to 13.4 NTU) of oat milk made from conventional oats cultivars when stored for 7 days. Meanwhile, pH and viscosity decreased. The stability, turbidity, pH and dry matter of organic oat cultivars oat milk were slightly different during storage from conventional oat cultivars. However, the viscosity was 2 times lower than that of conventionally oat cultivars: from 27.24 cP at 1st day to 24.05 cP at 7th day of organic oat milk and from 82.26 cP at 1st day to 69.67 cP at 7th day of conventional oat milk.

Keywords: oat milk, organic cultivar, conventional cultivar, amylase, viscosity, turbidity.

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Effect of Cell Culture Additives on Aggregation of SARS-CoV-2 Nuleocapsid Protein with RNA.

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Abstract

The Nucleocapsid (N) protein is one of four structural proteins that make up the viral particle of SARS-CoV-2 and is responsible for the packaging and protection of the virus' genomic RNA during its life cycle. Due to the conservative amino acid sequence, strong immunogenicity and key role during viral replication of the N protein in comparison to other SARS-CoV-2 structural proteins, it is an attractive target for the development of vaccines, anti-viral medications and for use in COVID-19 diagnostics [1]. Although the replication of the SARS-CoV-2 virus occurs inside the cell, the N protein can be found exposed on the cell surface and in the extracellular space during active infection [2]. The concentration of N protein in blood serum has been shown to correlate with severity of symptoms and patient outcomes [3].

The N protein, upon binding to viral genomic RNA and/or oligomerization, goes through liquid-liquid phase separation and forms biomolecular condensates, which can be observed by optical microscopy [4]. In mammals, RNA found in the extracellular space is hypothesized to be used by cells for distant communication [5]. The N protein has also been shown to be able to bind host mRNA and other nucleic acids that are not SARS-CoV-2 genomic RNA [6]. By interacting with extracellular RNA, N protein may alter the availability of RNA ligands for pattern recognition receptors, thereby modulating immune sensing and downstream inflammatory signalling.

To evaluate the cellular response to these N protein-RNA condensates in cell culture, it is vital to ensure that phase separation occurs consistently and in a controlled manner during experiments within the cell culture medium. We present our findings on how common cell culture media and additives affect the ability of N protein to undergo phase separation with RNA, utilizing bright field microscopy imaging of resulting biomolecular condensates.

Keywords: SARS-CoV-2, nucleocapsid protein, extracellular RNA.

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Repurposing of Commercial Hydrogen Fuel Cells

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Abstract

Development of hydrogen fuel cell vehicles has resulted in the availability of highly engineered, durable, and efficient fuel cell stacks designed for automotive applications. However, as the commercial viability of hydrogen transport remains constrained by infrastructure and cost challenges, opportunities emerge for repurposing these advanced systems beyond their original use cases. This study explores the practical reuse of individual fuel cells derived from the Toyota Mirai MK2 stack as modular demonstration units and small-scale hydrogen-powered generators.

The research focuses on the extraction, characterization, and integration of single cells into low-power systems suitable for educational, experimental, and auxiliary energy applications. Electrical performance, thermal behavior, and system stability were evaluated under controlled operating conditions. Results demonstrate that individual cells can reliably produce usable electrical output when paired with simplified balance-of-plant components, enabling compact and accessible hydrogen energy systems.

The repurposed cells offer a cost-effective platform for hands-on learning and prototyping, significantly lowering barriers to entry compared to full-stack systems. Additionally, their use as micro-generators highlights potential niche applications where modular hydrogen-based power may be advantageous.

This work contributes to the circular use of fuel cell technologies by extending the lifecycle of automotive-grade components and providing practical pathways for their reuse in research and education. It also raises broader questions regarding the future role of hydrogen technologies and the value of repurposing existing assets in a transitioning energy landscape.

Keywords: hydrogen fuel cells, fuel cell repurposing, modular energy systems, circular economy.

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Effect of Different Time Intervals of Ultrasound-Assisted Extraction on Polyphenolic Content of Dandelion Leaves

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Abstract

Dandelion belongs to the *Asteraceae* family and the *Taraxacum* genus. It is a perennial plant with wide distribution in subtropical and temperate regions of the Northern Hemisphere [1]. Although commonly regarded as a weed it can be utilized as a source of phytochemicals in alignment with principles of circular economy [2-3]. Ultrasonic assisted extraction (UAE) is considered a green alternative to conventional extraction methods such as Soxhlet extraction and maceration [4]. Extraction efficiency in UAE depends on factors such as sonication duration and frequency and the intrinsic properties of the plant, both of which may influence phytochemical yield [5]. Therefore, optimization of the ultrasonic extraction becomes relevant for each of the plant types.

In this study, dry dandelion leaves (*Taraxacum* spp.) were extracted with 70% methanol using two solid-to-solvent ratios (1:40 and 1:20) for varying durations (15, 30, 45, and 60 minutes). A control sample was kept at room temperature for 60 minutes without sonication. Total phenolic content was quantified using the Folin–Ciocalteu assay [6].

The Shapiro–Wilk test was used to assess the normality of the data. When the normality assumption was met, a one-way ANOVA followed by Tukey's HSD post-hoc test was applied. When normality was violated, Welch's ANOVA with the Games–Howell post-hoc test was used instead.

No statistically significant ($p \leq 0.05$) differences in total polyphenolic content were detected across the four sonication time intervals for the 1:40 solid-to-solvent volume ratio. 15-, 45- and 60- minute sonification intervals had statistically significant difference with control ($p \leq 0.05$). The highest polyphenol yield within this group was observed at 60 minutes of sonication, reaching 67.40±3.30 mg of rutin equivalents per gram of dry sample. For the 1:20 extraction ratio, the sample subjected to 60 minutes of ultrasonic treatment produced a significantly higher ($p \leq 0.05$) polyphenolic yield (92.88±2.11 mg of rutin equivalents per gram of dry sample) than all other 1:20 time sonication intervals. Overall, the findings highlight the importance of optimizing extraction parameters in ultrasound-assisted extraction. The combination of a 1:20 solid-to-solvent ratio and 60 minutes of sonication resulted in the highest polyphenolic yield, indicating that extraction efficiency rather than the intrinsic phenolic content of the plant material governs the observed differences.

Keywords: polyphenolic compounds, ultrasonic assisted extraction, dandelion.

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Investigation of Sugar Beet Pulp Utilization for Bioethanol Production

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Abstract

High-fibre sugar beet pulp (SBP) was evaluated as a feedstock for bioethanol production using an integrated ultrasound and hydrothermal pretreatment, enzymatic liquefaction and yeast fermentation strategy. SBP hydrolysates were produced by using commercial enzyme preparations containing cellulase, xylanase, hemicellulases, and pectinases (Viscoferm, Viscozyme L, and Pectinex Ultra Tropical). Following liquefaction, fermentation was carried out using the most effective yeast strains, such as *Saccharomyces cerevisiae* and *Candida tropicalis*, applied both as monocultures and as a mixed culture to improve the utilisation of not only hexose but also pentose sugars. Fermentation performance was evaluated under simultaneous saccharification and fermentation (SSF) conditions by monitoring sugar consumption and ethanol production. The combination of Viscozyme L and Pectinex UT allowed the initial concentration of reducing sugars in the SBP hydrolysate to reach up to 180 mg/mL. Both *S. cerevisiae* and *C. tropicalis* showed similar efficiency in sugar utilisation, resulting in ethanol concentrations ranging up to 2% (v/v) during 48-72 h of yeast fermentation. The mixed-culture approach was further investigated to enhance overall carbon conversion from SBP by extending substrate utilisation beyond readily fermentable hexoses. Hydrothermal pre-treatment and pre-longed co-fermentation with both yeast strains enabled the utilisation of both hexose and pentose sugars and increased ethanol production to up to 4% (v/v). Overall, SBP pretreatment and enzymatic hydrolysis combined with targeted yeast selection demonstrates the potential for efficient SBP valorisation into bioethanol at high substrate (30 g dm/100 mL) loadings. In addition, mixed-culture fermentation represents a promising strategy for improved conversion of pentose-rich hydrolysates.

Keywords: sugar beet pulp, ultrasound, fibre degradation, pentose-rich hydrolysate, yeast fermentation, bioethanol.

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Nisin Variants: Evaluating the Dual-Action Potential of Bacteriocins in Antimicrobial and Oncological Applications

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Abstract

Glioblastoma Multiforme (GBM) is the most common and aggressive malignant solid tumor of the central nervous system (CNS). Despite a standard clinical regimen of surgical resection, radiation, and chemotherapy, treatment efficacy remains severely limited, with an average patient survival of only 15 months and a 5 year survival rate of less than 5% [1]. Parallel to these oncological challenges, the global surge in antibiotic resistance has created an urgent need for novel antimicrobial agents [2]. Nisin, a bacteriocin traditionally used in food preservation, has emerged as a promising candidate to address both crises. Beyond its potential as a novel antibacterial compound, nisin demonstrates an ability to target cancer cells. This dual threat capability allows it to act as both a potent antimicrobial and a targeted anticancer agent, addressing two of the most significant challenges in modern medicine.

This study aimed to investigate the antibacterial and oncological potential of nisin variants, nisin A (solid), nisin A (ready made solution), and nisin Z, specifically focusing on their efficacy against the U87 glioblastoma cell line and their ability to work synergistically with the standard chemotherapeutic drug temozolomide (TMZ).

The inhibitory activity of nisin variants (A and Z) was first evaluated using the agar well diffusion assay to determine baseline potency against model pathogens: *E. coli* (for negative control), *E. faecalis*, *M. luteus* and *S. aureus*. For the oncological application, cytotoxicity was assessed on glioblastoma U87 cell line using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assays. First, cells were treated with a range of concentrations of nisin variants to establish dose response curves and determine the IC_{50}. This was followed by synergy MTT assay to evaluate the interaction between nisin variants and TMZ, assessing whether the combined treatment yielded a more effective reduction in cell viability.

The well diffusion assay confirmed the antibacterial activity of both nisin variants, reinforcing their potential as alternatives to traditional antibiotics in the face of rising resistance. In the oncological phase, MTT assays demonstrated that nisin variants induced dose dependent cytotoxicity in U87 glioblastoma cells. The preliminary results of nisin and temozolomide MTT assays showed synergistic effect, effectively reducing the viability of U87 cells at lower concentrations than those required for TMZ alone. These results suggest that nisin variants can sensitize glioblastoma cells to chemotherapy, thereby enhancing the standard therapeutic TMZ treatment.

Keywords: glioblastoma multiforme (GBM), bacteriocins, nisin, oncology, synergistic effect.

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Contamination of Fresh and Dried Lithuanian Apples with Micromycetes and Evaluation of Essential Oils Antifungal Activity

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Abstract

Fruits are widely consumed due to their nutritional value; however, they are susceptible to contamination by mycromicetes, which may pose health risks [1,5]. Information about fresh and dried fruits is becoming increasingly relevant, as evidenced by growing consumer demand for healthy, high-quality food and a greater focus on food safety. Object of the study was Organically grown fresh Lithuanian apples and dried apples, and their contamination with micromycetes. Aim of the study was evaluate the contamination of organically grown Lithuanian fresh apples, apples dried using different methods (at room temperature (18–20 °C), in an oven (75 °C), and in a dryer (60 °C)), and dried apples purchased from supermarkets, as well as to assess the antifungal activity of selected essential oils. The study analyzed fresh and dried apple samples using microbiological methods, including surface plating with serial dilutions to determine total yeast and mold counts and direct plating to evaluate mold distribution [4]. Microscopic analysis was performed for identification of mold genera. The antifungal activity of three essential oils, namely Chinese cinnamon bark (*Cinnamomum cassia*), true lavender (*Lavandula angustifolia*), and thyme (*Thymus zygis* L.), was evaluated using the disk diffusion method against selected micromycetes (*Penicillium oxalicum*, *Aspergillus niger*, *Cladosporium cladosporioides*, *Rhizopus stolonifer*) [3]. The results showed that the highest total yeast and mold count was detected in fresh apples (5.03±0.01 CFU/g), while drying significantly reduced microbial contamination. A diverse range of mold genera was identified, with *Penicillium*, *Cladosporium*, *Alternaria*, *Aspergillus*, and *Rhizopus* being the most common. The antifungal activity against micromycete cultures, tested at different essential oil concentrations (50%, 25%, 10%, 5%, 3%, 2%, 1%, 0.5%). The antifungal effect of essential oils depended on their type and concentration, with *Cinnamomum cassia* essential oil demonstrating the strongest inhibitory activity against most tested micromycetes *(Penicillium*, *Cladosporium*, *Aspergillus*). The findings indicate that although drying reduces microbial load, contamination is not eliminated, and essential oils may serve as a natural alternative for controlling fungal growth in food products, because it was demonstrated strong antifungal activity.

Keywords: yeast and mold contamination, drying effect, essential oils, micromycetes, antifungal activity.

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Dynamics of Micromycete Distribution in Bread Products and Their Control Methods

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Abstract

Bread is an important part of a balanced diet. Whole-grain bread is rich in dietary fiber, proteins, vitamins, and micronutrients, and contains low levels of sugars [1]. Moreover, bread consumption worldwide continues to increase every year (from 2018 to 2022, bread consumption increased by 2%). However, bread products, like many other processed foods, are physically, chemically, and microbiologically vulnerable [2]. The main issue affecting bread shelf life is contamination by molds [3]. In addition to visible growth, fungi can cause off-flavors and produce mycotoxins as well as allergenic compounds. Data from the Food and Agriculture Organization (FAO) indicate that approximately 25% of the world's food products are contaminated with mycotoxins [4]. Continuous consumption of mycotoxin-contaminated food poses serious risks to the respiratory, digestive, nervous, and other body systems [5]. The most common fungal genera contaminating bread belong to *Eurotium, Aspergillus, Monilia, Mucor, Cladosporium, Fusarium*, and *Rhizopus* [6]. So, the aim of the study was to investigate the dynamics of micromycete distribution in selected Lithuanian bread products and to evaluate the effectiveness of plant-based and physical factors in inhibiting their growth. The study revealed that the most prevalent micromycetes in bread products were *Aspergillus niger* and *Penicillium chrysogenum*, with the highest contamination found in 100% rye organic bread. *Cinnamomum verum* completely inhibited mold growth, *Curcuma longa* showed strong inhibitory effects, while *Salvia rosmarinus* had the weakest effect. UV radiation effectively inhibited mold growth, and its efficiency increased with longer exposure time; *Penicillium chrysogenum* was more sensitive than *Aspergillus niger*. Ultrasound was more effective against *Aspergillus niger*. Additionally, UV radiation stimulated melanin synthesis, whereas ultrasound caused strong initial damage followed by only partial recovery.

Keywords: *Aspergillus niger*, *Penicillium chrysogenum*, *Cinnamomum verum*, *Curcuma longa*, *Salvia rosmarinus.*

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Plant Secondary Metabolites – Protection Against Airborne Microorganisms

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Abstract

One of the most significant contemporary challenges is the disinfection of indoor air. Air pollution represents a substantial risk to human health. Biological air contamination is most frequently caused by plant pollen, fungi, bacteria, and viruses, which may lead to severe diseases, infections, and, in many cases, respiratory disorders. Therefore, the removal of pathogenic microorganisms from indoor environments can be regarded as an important strategy for improving public health. Currently, plant secondary metabolites are being extensively investigated as potential agents for enhancing indoor air quality. Essential oils derived from plants are complex volatile mixtures containing terpenes and their derivatives, which exhibit antimicrobial properties. Due to their volatility, essential oils possess considerable potential as agents for reducing microbial contamination in indoor air. This study examines the antifungal volatile effects of essential oils obtained from thyme (*Thymus vulgaris*) and tea tree (*Melaleuca alternifolia*) in enclosed indoor environments. A cotton pad diffusion method was employed to evaluate the antimicrobial activity of these essential oils against *Saccharomyces boulardii*, *Penicillium roqueforti*, and *Penicillium candidum*. This method was selected in consideration of the volatile nature of essential oils.

Aim of the study was to evaluate the antimicrobial activity of essential oils (*Thymus vulgaris* and *Melaleuca alternifolia*) against *Saccharomyces boulardii*, *Penicillium roqueforti*, and *Penicillium candidum*.

The antimicrobial activity of essential oils (*Thymus vulgaris* and *Melaleuca alternifolia*) against the selected microorganisms was assessed using the disc diffusion method. Antimicrobial efficacy was determined based on the percentage reduction in colony counts compared with control samples. The obtained data were analyzed using descriptive statistical methods.

The essential oil of *Thymus vulgaris* exhibited the strongest antimicrobial activity, whereas *Melaleuca alternifolia* essential oil demonstrated comparatively lower activity. The highest inhibitory effect of the tested essential oils was observed against *Saccharomyces boulardii* and *Penicillium roqueforti*, while the lowest activity was recorded against *Penicillium candidum*. Essential oils derived from aromatic plants exhibit a broad spectrum of antimicrobial activity and may be considered a promising natural alternative or an adjunct to conventional antimicrobial therapies.

Keywords: antimicrobial, essential oil, disinfection of air, *Thymus vulgaris*, *Melaleuca alternifolia, Saccharomyces boulardii*, *Penicillium roqueforti*, *Penicillium candidum*.

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From Extraction to Anticancer Potential: Phytochemical Profiling and Bioactivity Evaluation of Ellagic Acid-Rich Medicinal Plants

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Abstract

Medicinal plants are valuable sources of biologically active secondary metabolites, including phenolic compounds with antioxidant and potential anticancer properties. Among these compounds, ellagic acid derivatives are of particular interest due to their reported ability to modulate oxidative stress, regulate cellular signalling pathways, and inhibit cancer cell proliferation [1, 2]. However, the contribution of specific phenolic compound groups to the antiproliferative activity of complex plant extracts remains insufficiently understood. This study evaluated the relationship between phytochemical composition, antioxidant activity, and anticancer potential of selected ellagic acid-rich medicinal plant extracts. The investigation combined medicinal plant extraction, C18 solid-phase extraction fractionation, spectrophotometric assays, high-performance liquid chromatography analysis, *in vitro* biological testing, and statistical evaluation [3-5]. Antiproliferative activity was assessed against 5 cancer cell lines (4T1, A549, Caki-1, HCT116, and MCF7), and cytotoxicity was evaluated using non-cancerous HEK-293 cells. Linear mixed-model analysis confirmed a significant incubation-time effect in all tested cancer cell lines, with IC_{50} values generally decreasing after prolonged exposure. Statistically significant F2-F3 differences were plant-dependent. The 30% (*v/v*) methanol in water fraction (F2), enriched in oenothein in *C. angustifolium* L., showed stronger antiproliferative activity, whereas 60% (*v/v*) methanol in water fraction (F3) showed stronger activity in *Q. robur* L., *J. nigra* L., *J. regia* L., and *S. canadensis* L. These findings indicate that antiproliferative activity was associated with the qualitative and quantitative composition of the selected phenolic-rich SPE fractions rather than with a single universal fraction effect. Importantly, all tested fractions showed minimal cytotoxicity toward HEK-293 cells, indicating potential selectivity against cancer cells.

Keywords: medicinal plants, ellagic acid derivatives, phenolic compounds, solid-phase extraction, antioxidant activity, antiproliferative activity, phytochemical profiling.

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Evaluation of Bioethanol Production from Coffee Spent Grounds Using Solid-State and Submerged Fermentation Processes

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Abstract

Coffee is among the most consumed beverages in the world. Statistically, global consumption of coffee beans in 2023 was approximately 10 million tons. Spent coffee grounds (SCGs) are rich in caffeine, coffee melanin, and phenolic compounds [1]. These compounds can become ecologically harmful when introduced into soil. Significant losses of land and reusable resources, as well as worsening climate impacts, occur when spent coffee grounds are landfilled or incinerated. Therefore, developing a cost-effective method for utilizing SCGs could enable their high-value reuse. Furthermore, glucose and mannose present in SCGs can be fermented by yeast to produce ethanol, improving the efficiency of cellulosic ethanol production [2].

Residues derived from *Pleurotus ostreatus* were employed as a solid biological pretreatment agent providing lignocellulolytic activity for spent coffee grounds (SCGs). This material was employed to hydrolyze the lignocellulosic fraction of the substrate prior to fermentation. Yeast was subsequently used for ethanol production from the released sugars. Therefore, the present study evaluated the potential of spent coffee grounds for bioethanol production using solid-state and liquid-state processes, combining fungal residue-based pretreatment with yeast fermentation. During solid-state fermentation, 0.17 g of bioethanol per gram of spent coffee grounds was produced, whereas liquid-state fermentation produced 0.12 g per gram.

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Environmental and Physical Drivers of Climate-Induced Vulnerability: A Situational Analysis of Kamalamai Municipality, Sindhuli, Nepal

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Abstract

Increasing rainfall variability, extreme precipitation, and rapid land-use change have intensified climate-induced flooding. While flood vulnerability is commonly assessed through socio-economic indicators, the environmental and physical factors that determine spatial characteristics of vulnerability remain underexplored at the municipal level. Using a convergent mixed-method design, we integrated Geographic Information System (GIS) analysis, household surveys, key informant interviews, and field observations across selected sites, this study examines how the environmental and physical conditions influence climate-induced flood vulnerability in Kamalmai Municipality, Sindhuli, Nepal. Results reveal that vulnerability is not solely a socio-economic condition but is fundamentally structured by environmental and geomorphological characteristics. Vulnerability exhibits strong spatial differentiation, closely associated with low elevation, proximity to river channels, high drainage density, and conversion of agricultural/forest land into built-up areas. These physical and environmental exposures such as access to formal planning, drainage infrastructure, emergency services and soil compaction from built up areas further amplify the climate risks affecting the adaptive capacities. These findings provide an empirical foundation for flood risk planning and land use regulation at the municipal level, which supports shifting from uniform interventions toward spatially targeted risk reduction strategies in small urban and peri-urban contexts. This study contributes to the scholarship by re-centering the environmental and physical vulnerability within climate risk analysis and conceptualizing vulnerability as a spatially conditioned outcome.

Keywords: flood vulnerability, environmental and physical determinants, spatial analysis, land use and land cover change, Nepal.

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Deactivation and Magnetization of *Trichoderma harzianum* Spores for Applications in Drug Delivery

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Abstract

In an attempt to fight further development and mutation of drug resistance in diseases, new targeted drug delivery methods are being sought [1]. Noval biotemplate methods that can be used to prescribe targeted treatments are being intensively studied [2]. This presentation explores *Trichoderma harzianum* spore deactivation and magnetization under different conditions for pharmaceutical purposes. *T. harzianum* spores exposed to UV-A or UV-C radiation for 1 hour showed reactivation, and so did spores heat at 90 °C for 30 minutes. Meanwhile, spores autoclaved at 121 °C for 1 hour showed complete deactivation. After evaluating the absorption of fluorescein, active *T. harzianum* spores absorbed 56.86% more fluorescein solution than deactivated spores – confirming the deactivation. *T. harzianum* spores were hollowed, magnetized and pulled by a magnet. These experimental results show that *T. harzianum* spores can be deactivated, hollowed, magnetized and later used as drug carriers for targeted treatment.

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Evaluation of the Hydrodynamic Properties of Synthetic Monolithic Sorbents

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Abstract

Monolithic sorbents are widely used in chromatographic analysis because of their high porosity, low flow resistance, and good permeability properties [1]. Lately, there has been growing attention to graphene-based materials because of their large specific surface area, chemical stability, and adsorption properties [2]. Integrating graphene oxide into monolithic structures may improve sorption characteristics; nonetheless, it could affect hydrodynamic permeability and flow behaviour [3]. The aim of this study was to explore how various polymerization formulations and graphene incorporation affect the hydrodynamic properties of monolithic sorbents synthesized in fused silica capillaries. Monolithic sorbents were synthesized in situ using piperazine diacrylamide (PDA) as a cross-linking monomer, 2-hydroxyethyl methacrylate (HEMA) as a monomer, and ammonium persulfate (APS) as an initiator. Different concentrations of PDA, ammonium sulphate, HEMA, and graphene oxide were evaluated. The created, synthesized capillaries were washed with bidistilled water using a liquid vacuum pump, and hydrodynamic permeability was assessed based on flow rate measurements (n = 5). The results proved that the composition of the polymerization mixture significantly influenced the hydrodynamic properties of monolithic sorbents. Flow rate measurements ranged from 0.0237 to 1.537 µl/(min·cm) based on the synthesis parameters. The highest permeability was achieved using the formulation containing 6 µl APS, 0.10 g PDA, 0.05 g ammonium sulphate, and 168 µl HEMA 10%. The incorporation of graphene oxide into the monolithic matrix decreased hydrodynamic permeability in many cases. In certain capillaries, the flow rate dropped by more than threefold compared to monoliths synthesized without graphene. These results show that graphene oxide affects the structure of monolithic sorbents by forming a denser porous network and reducing effective flow channels [3]. The research confirmed that polymerization parameters and graphene modification significantly influence the structure and hydrodynamic flow of monolithic sorbents. Optimized synthesis conditions could enable the preparation of monolithic capillaries with regulated permeability and enhanced chromatographic characteristics.

Keywords: monolithic sorbents, graphene oxide, hydrodynamic permeability, capillary columns, polymerization, flow rate.

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Assessment of Genetic Variation in *Impatiens parviflora* DC. Populations

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Abstract

Impatiens parviflora DC., commonly known as small balsam, is a non-native species originating from Central Asia that has widely spread across Europe due to its ecological adaptability. It typically occurs in shaded and moist habitats, where it may negatively affect native biodiversity and alter plant community structure [1]. In Lithuania, the species is widely distributed and considered invasive. The aim of this study was to evaluate the genetic variation of *I. parviflora* populations using chloroplast DNA (cpDNA) markers. Plant material was collected from different regions. Leaf samples were stored at low temperature prior to DNA extraction, after which DNA quality was assessed and four non-coding cpDNA regions were selected for analysis. These markers are widely used in plant phylogenetic and population-level studies due to their variability and suitability for detecting genetic relationships [2, 3]. Studies on chloroplast genomes within the genus *Impatiens* support their applicability in evolutionary research [4, 5]. No polymorphism was detected among individuals from different populations, indicating low cpDNA variation. This may reflect a limited number of maternal lineages and is consistent with founder effects during species introduction. Historical data indicate that *I. parviflora* was introduced into Western Europe in the early 19th century and reached Lithuania later through secondary dispersal [6]. Comparison with GenBank data showed that Lithuanian samples are most similar to populations from Northern and Western Europe. The *psbA–trnH* region showed highest similarity with sequences from Sweden and Switzerland, while *rps16* and *rpl32–trnL* corresponded to populations from the United Kingdom [5]. These results support the hypothesis of secondary spread within Europe. In comparison with other species of the genus *Impatiens*, such as *Impatiens glandulifera*, which often exhibits higher genetic diversity in invaded regions, *I. parviflora* shows reduced cpDNA variability [7]. Comparative studies further confirm the usefulness of cpDNA markers in identifying invasion pathways and geographic patterns of spread [7–10]. Overall, cpDNA markers were suitable for identifying general genetic relationships but showed limited resolution at the population level. Future studies should include additional markers and a larger number of samples.

Keywords: *Impatiens,* invasive species, DNA markers, genetic variation, plant invasions.

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