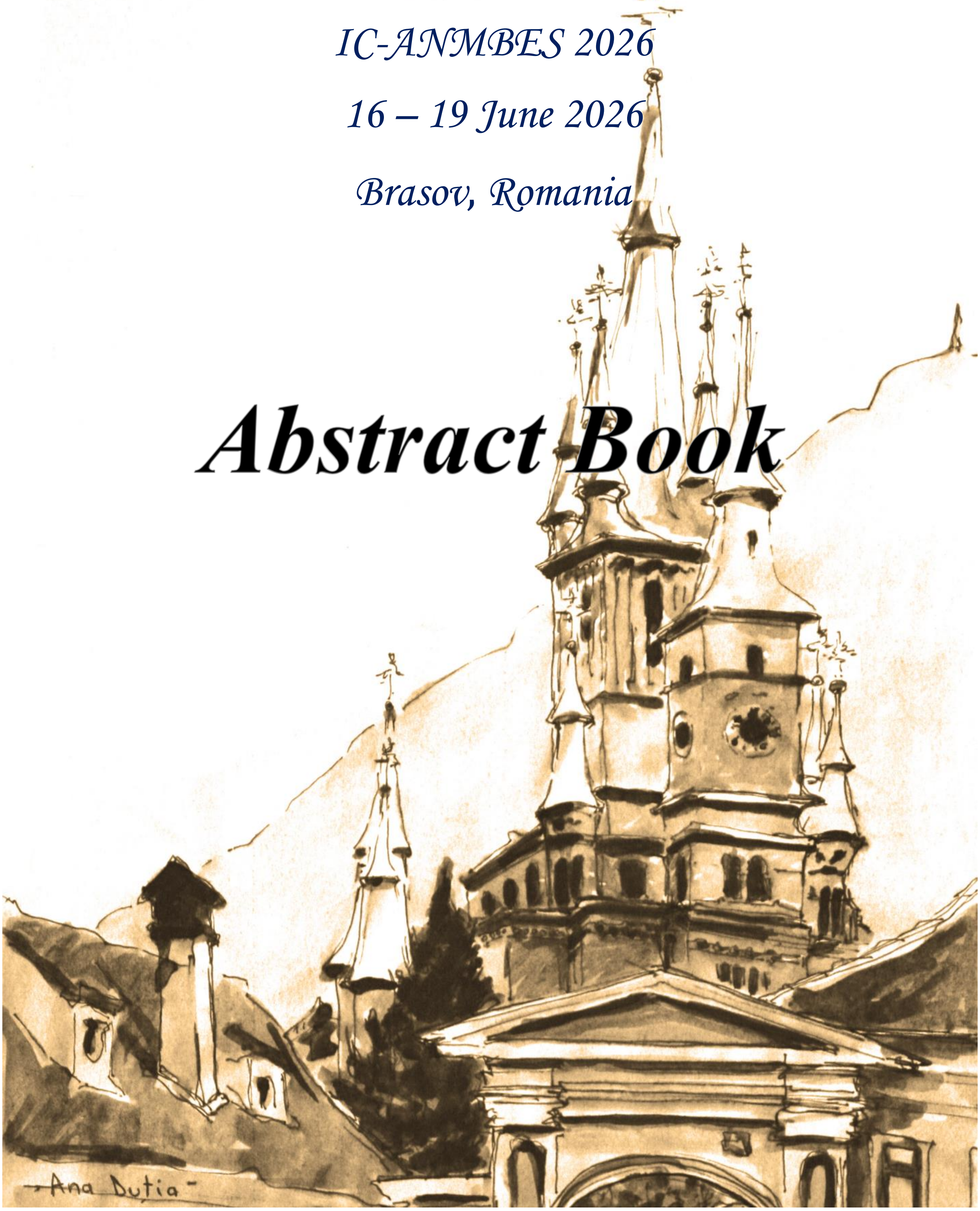
Analytical and Nanoanalytical Methods for Biomedical and Environmental Sciences

IC-ANMBES 2026

16 – 19 June 2026

Brasov, Romania

Abstract Book



***TRANSILVANIA* UNIVERSITY OF BRAŞOV**

International Conference on Analytical and Nanoanalytical Methods for Biomedical and Environmental Sciences

IC-ANMBES 2026

BOOK OF ABSTRACTS

Braşov, 16th -19th June, 2026

Editors: Monica Florescu
Dana Alina Magdaş
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Transilvania University Press

2026

EDITURA UNIVERSITĂŢII TRANSILVANIA DIN BRAŞOV

Adresa: 500091 Braşov
B-dul. Iuliu Maniu 41A
Tel: 0268-476050
Fax: 0268-476051
Email: editura@unitbv.ro

Editură acreditată de CNCSIS
Adresa nr. 1615 din 29 mai 2002

ISSN 2360-3461

ISSN-L 2360-3461

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SCIENTIFIC PROGRAMME

ORAL COMMUNICATIONS

16th June 2026

15:30 – 16:45	**Registration**	
	Room: Aula Magna **Chairs: Monica Florescu, Alina Magdas, André Matagne**	
16:45 – 17:00	**Opening Ceremony**	
	Keynote talks	
17:00 – 17:30	**K-1. Erik Beckert**	Fast dielectrophoretic, AI image analysis enabled sorting of single cells in a microfluidic system
17:30 – 18:00	**K-2. Bertrand Raynal**	Is mass photometry a new gold standard for mass measurement
18:00 – 18:30	**K-3. Dana Alina Magdas**	The integration of data from multiple sources to enhance the capabilities of food recognition models
18:30 – 20:30	**Welcome Party**	

17th June 2026

08:30 – 09:00	**Registration**	
	T5 - Biomedical Innovation & Translational Nanomedicine. Biophysical Approaches for Protein Science	
	Room: Aula Magna **Chair: Erik Beckert, Mark Wallace**	
	Keynote talks	
09:00 – 09:30	**K-4. André Matagne**	Multiple Roads to Fold: Modular Assembly of a Class A β-Lactamase Monitored by High-Resolution Hydrogen-Deuterium Exchange
09:30 – 10:00	**K-5. Andra C. Dumitru**	Multiscale Nanomechanics of Biological Systems Revealed by bioAFM

10:00 – 10:30	**K-6. Stefania Maria Filomena Mitola**	VEGFR2-Driven Extracellular Matrix Remodeling Sustains Tumor Growth
	Invited early researcher talk	
10:30 – 10:50	**I-1. Julien Mignon**	Deciphering the Fibrillation Pathway and Determinants of Paramyxovirus P/V/W Proteins: a Dialogue Between Experimental and Computational Biophysics
10:50 – 11:20	**Coffee Break and Poster Session**	
	T2 - AI-Driven Laboratories & Smart Analytics	
	Room: Aula Magna **Chairs: Gregor Anderluh, Andra C. Dumitru**	
	Keynote talks	
11:20 – 11:50	**K-7. Mark Wallace**	Digital Microfluidics and Microfabrication for Cell Membrane Mimetics
11:50 – 12:20	**K-8. Stefan G. Stanciu**	Scattering-type Scanning Near-field Optical Microscopy: Architectural Developments, Applications and Data-Driven Approaches
	Contributed talks	
12:20 – 12:35	**O-1. Mihaela Moisescu**	Bridging Electrical and Optical Signatures: A Unified Platform for Single-Cell Characterization
12:35 – 12:50	**O-2. Violeta L. Calin**	HoloPath – Intelligent Procedure based on Digital Holographic Imaging for Digital Pathology
12:50 – 13:05	**O-3. Constantin Losmanschii**	Quantitative Investigation of Cellular Anisotropy Using Polarization Digital Holographic Microscopy
13:05 – 14:00	**Lunch**	

14:00 – 15:00	**Poster Presentation Session**	
	T4 - Advancing Analytical Science for a Sustainable Future - Food production and authentication	
	Room: Aula Magna **Chair: Alina Magdas, Mihaela Sofronie**	
	Keynote talks	
15:00 – 15:30	**K-9. Isabel Borrás-Linares**	Application of HPLC-HR-MS for the Characterization of Bioactive Compounds in Encapsulated Plant-Based Ingredients
15:30 – 16:00	**K-10. Marco Ciulu**	The Triple Challenge in Honey Authentication: Dynamic Datasets, Novel Markers and Screening Strategies
	Invited early researcher talk	
16:00 – 16:20	**I-2. Alexandru Nicolescu**	Optimization of Extraction Methods for Plant Analysis: Toward Efficient, Sustainable, and Selective Approaches
	Contributed talks	
16:20 – 16:35	**O-4. Lacramioara Oprica**	Synthesis of Silver Nanoparticles using Grape Pomace Extracts with Superior Visible Light Photocatalytic Activity and Evaluation of their Effects on Wheat (Triticum aestivum L.)
16:35 – 16:50	**O-5. Maria David**	Multi-analytical Approaches Applied for the Authentication of Spices and Herbs
16:50 – 17:05	**O-6. Cristian Chisbora**	Challenges in Geographical Origin Authentication of Food Ingredients Using Isotopic Fingerprinting: the Case of Angus Beef Meat
18:30 – 22:00	**Gala Dinner at RESTAURANT PANORAMIC,** **Aleea Tiberiu Brediceanu 1B Bis, 500014 Brașov**	

18th June 2026

09:00 – 09:30	**Registration**	
	T2 - AI-Driven Laboratories & Smart Analytics	
	Room: Aula Magna **Chairs: Stefania Maria Filomena Mitola, Bertrand Raynal**	
	Keynote talk	
09:30 – 10:00	**K-11. Silvia Cirstea**	Deep Learning Architectures for Precision Oncology
	Contributed talks	
10:00 – 10:15	**O-7. Markus Zetes**	Random Forest–Driven Feature Selection and Metabolite Panel Identification in Urinary Metabolomics for Breast Cancer Classification
10:15 – 10:30	**O-8. Nicolas Leto**	Molecular Dynamic Model Robustness Evaluation For 2D Nanoflakes-Bacterium Interactions in Solution
10:30 – 10:45	**O-9. Adrian Șerban**	Automated Large-Scale Bayesian AUC Estimation Using Web-Based Platforms: A scalable data Analysis pipeline for clinical pharmacokinetics
10:45 – 11:00	**O-10. Natalia Bolocan** (online)	Operational Thermodynamic Criterion for Detecting Non Additive Effects in Complex Aqueous Systems from Experimental Data
11:00 – 11:30	**Coffee Break and Poster Session**	
	T1 - Innovative Analytical Instruments and Platforms	
	Room: Aula Magna **Chairs: Azrul Azlan Hamzah, Isabel Borrás-Linares**	
	Keynote talk	
11:30 – 12:00	**K-12. Christina Sizun**	How Far Can Liquid State NMR Spectroscopy Take Us in Studying Peptide-Liposome Formulations?

	Invited early researcher talk	
12:00 – 12:20	**I-3. Arkadiusz P. Matwijczuk**	Proton-coupled Excited-state Pathways Governing Ultralong Room-temperature Phosphorescence in a Coumarin Luminophore
	Contributed talks	
12:20 – 12:35	**O-11. Julia Baumli**	From HPTLC Bioactivity Profiling to HR-MS/MS Characterization of Lamium album
12:35 – 12:50	**O-12. Vladislav Botnari**	Jones Matrix Reconstruction of Polarization Diffraction Gratings
12:50 – 13:10	**Photo session**	
13:10 – 14:30	**Lunch and Poster Session**	
	T3 - Advanced Materials & Nanotechnology	
	Room: Aula Magna **Chairs: Christina Sizun, Stefan G. Stanciu**	
	Keynote talk	
14:30 – 15:00	**K-13. Mihaela Sofronie**	Advanced Magnetic Materials: From Ferromagnetic Shape Memory Alloys to Smart Biomaterials Functionalities
	Invited early researcher talk	
15:00 – 15:20	**I-4. Alia Colniţă**	Tailoring Plasmonic Nanostructures via Nanoimprint Lithography for High-Performance SERS
	Contributed talks	
15:20 – 15:35	**O-13. Artur Jędrzak**	Nanoengineered Biomaterials for Enhanced Diabetes Monitoring
15:35 – 15:50	**O-14. Livia Alexandra Dinu**	Microfabricated Si/SiO_2 Electrodes Functionalized with Molecularly Imprinted Polymers for Detection of Environmental Contaminants

15:50 – 16:05	**O-15. Roxana Strungaru-Jijie**	Microplastics in Aquatic Ecosystems: Assessment and Remediation by Advanced Oxidation Processes
16:05 – 16:30	**Coffee Break and Poster Session**	
	T5 - Biomedical Innovation & Translational Nanomedicine	
	Room: Aula Magna **Chairs: André Matagne**	
	Keynote talks	
16:30 – 17:00	**K-14. Gregor Anderluh**	Engineering a Pore-Forming Protein for Efficient Discrimination of Medically Important Proteins
17:00 – 17:30	**K-15. Liviu Movileanu**	Bioinspired Nanopore Sensors for Probing Transient Molecular Hallmarks in Neurodegeneration
17:30 – 18:00	**K-16. Brindusa Alina Petre** (online)	Functional Peptides: From Design and Synthesis to Biomedical Applications

19th June 2026

08:45 – 09:00	**Registration**	
	T5 - Biomedical Innovation & Translational Nanomedicine	
	Room: Aula Magna **Chairs: Liviu Movileanu, Silvia Cirstea**	
	Keynote talks	
09:00 – 09:30	**K-17. Azrul Azlan Hamzah**	Recent Advances in Wearable and Implantable Artificial Kidney and Global Collaborations towards Commercialization
09:30 – 10:00	**K-18. Silvana Andreescu**	Electrochemical Microbiosensors for Real-Time Neurochemical and Redox Monitoring in Living Tissues

10:00 – 10:30	**K-19. Rabeay Hassan** (online)	Multiplexed Label-Free Electrochemical Immunosensing for Rapid Diagnosis of Cancer and Neurodegenerative Disorders
	Contributed talks	
10:30 – 10:45	**O-16. Ana-Maria Chiorcea-Paquim**	Electrochemical and AFM Characterisation of POT1 Binding Mechanisms with Human Telomeric DNA
10:45 – 11:00	**O-17. Michaila Akathi Pantelaiou**	Synthesis of Amphiphilic Multi-responsive Terpolymers: Nanoformulation Studies with Anticancer and Aggregation-Induced Emission Molecules
11:00 – 11:30	**Coffee Break**	
	Room: Aula Magna **Chairs: Silvana Andreescu, Marco Ciulu**	
	T3 - Advanced Materials & Nanotechnology,	
	Contributed talks	
11:30 – 11:45	**O-18. Monica Enculescu**	Semiconducting Nanotubes and Nanoparticles-Polymer Composites with Photocatalytic Properties
11:45 – 12:00	**O-19. Alexandra Mocanu**	Design of Innovative Bacterial Cellulose-Based Gels for Wound Dressing Applications
	T4 - Environmental Forensics and Pollution Monitoring	
	Invited early researcher talk	
12:00 – 12:20	**I-5. Afef Dhaffouli**	From Juniper Biomass to Functional Electrochemical Interfaces: An Electroactivated MOF/Biochar Platform for Carbendazim Detection

	Contributed talks	
12:20 – 12:35	**O-20. Nerea Villarino García**	Plasmonic Colorimetric Detection of Volatile Analytes Using Core-shell Gold-silver Nanoparticles on Cellulose Substrates and Liquid Films
12:35 – 12:50	**O-21. Vanesa Romero**	Miniaturized Fluorometric Determination of Nitrite in Water Using Hydrophobic Paper-Based Analytical Devices
12:50 – 13:20	**Awards and Closing Ceremony**	
14:00 – 22:00	**Social Program – Visit of Brașov and Dinner**	

POSTER COMMUNICATIONS

No.	**Authors**	**Title**
P-1.	Mihaela-Andreea Ilisanu, Mona Mihailescu, Ana-Maria Pleava, Andrei Ungureanu, Ion Gabriel Vladu, Darius-Mihail Cristea, Vlad Fechete, Alina Ghioca, Elena Tianu, Valentin Popescu, Mihaela G. Moisescu, Violeta L. Călin	Comparison of scalar and vector features for segmentation of stained and unstained cells from cavity serous fluids
P-2.	Alexandru Nicolescu, Dana Alina Magdaş, Ioana Feher, Cornelia Veronica Floare-Avram, Lenuta Nicoara, Denisa Oltean, Adrian Costea, Florina-Dorina Covaciu	Nutritional quality of fresh cow cheese based on GC-FID analysis: fatty acid composition and cardiovascular indices
P-3.	Maria David, Ariana Raluca Magdas, Camelia Berghian-Grosan, Dana Alina Magdas	Vibrational Spectroscopy as a Rapid Tool for Spice Authentication
P-4.	Cristian Chisbora, Ioana Feher, Veronica Avram, Ionela Sonca, Roxana Pacurariu, Dana-Alina Magdas, Florina Covaciu	Beef tripe as an unusual source of healthy fatty acids
P-5.	Arkadiusz Matwijczuk, Lidia Ślusarczyk, Aleksandra Hnydka-Raniewicz, Dariusz Karcz, Katarzyna Klimek	Exploration of novel antifungal agents capable of forming synergistic interactions with polyene and azole antibiotics
P-6.	Andra-Sorina Tătar, Melinda David, Daniel Marconi, Nicoleta Elena Dina, Monica Florescu, Alia Colniță	Aptamer-Functionalized Au Nanotrenches Arrays for the Ultrasensitive Detection of Acetylcholine
P-7.	Roxana Strungaru-Jijie, Brinza Loredana, Vasile Tiron	Insight into the photo(piezo)-assisted adsorption and catalytic activity of nanostructured ZnO coatings and FHY nanoparticles for the degradation of Reactive Red 120 dye
P-8.	Laura Darie-Ion, Corina Ciobănașu, Brîndușa Alina Petre	Peptide Substrates-Based Approaches for Enzymatic Diagnosis of Rare Diseases
P-9.	Arifah Syahirah Abdul Rahman, Fook-Choe Cheah, Masitah Balqis Ilham Shah, Siti Noredyani Abdul Rahman, Hanis Nabilah Norazli, Nur Maisarah Fuat, Mohd Eusoff Azizol Nashriby, Chang Fu Dee, Muhamad Ramdzan Buyong, Mohd Ambri Mohamed, Poh Choon Ooi, Muhammad Irfan Abdul Jalal, Ahmad Ghadafi Ismail, Azrul Azlan Hamzah	Mixture viscosity and effective hardness of lignocaine-embedded maltose-based dissolvable microneedles

P-10.	AM Chiorcea-Paquim, S Paulino, R Nora, JMS Almeida, CMA Brett	DES-Electropolymerised MWCNT Sensor for Dual Salicylic Acid and Acetaminophen Detection
P-11.	Monica Enculescu, Anca Aldea, Maria-Lorena Jinga, Irina Tsvetkova, Bogdan Dragnea	Assembly Mechanisms of Virus-Like Particles Incorporating Gold Nanoparticles
P-12.	Klaudia Rząd, Lidia Ślusarczyk, Monica Florescu, Sylwia Okoń, Arkadiusz Matwijczuk	Spectroscopic studies of molecular aggregation in the ESIPT process on the example of a selected 1,3,4-thiadiazole derivative in a micellar system
P-13.	Ana Neacsu, Ancuta Mihaela Sofronia, Aurica Precupas, Daniela Gheorghe	A Calorimetric Study of Two Structurally Amino Compounds
P-14.	Aurica Precupas, Raluca-Marieta Toma, Vlad Tudor Popa, Daniela Gheorghe	Mechanistic Insights into Lysozyme Fibrillation Modulated by Gallic Acid
P-15.	Alexandra Busuioc, Ludmila Aricov, Anca Ruxandra Leonties, Vlad Tudor Popa, Aurica Precupas	The Effect of Quercetin on Protein Aggregation
P-16.	Florina Pogacean, Lidia Magerusan, and Stela Pruneanu	A Novel Sensitive Voltammetric Approach for Tartrazine Food Additive Detection
P-17.	Lidia Magerusan, Florina Pogacean and Cezara Voica	Valorisation of Agricultural Waste into Effective Sensing Materials for 2-Nitroaniline Assay
P-18.	Ioana Plăeşu, Andreea Stamatiu, Georgiana-Alexandra Sanda, Elvira Alexandrescu, Cristian Petcu, Ludmila-Otilia Cinteză	Rational designed multifunctional coatings for superhydrophobic surfaces using flower-like metal-oxide NPs.
P-19.	Delia Maria Luca, Lacramioara Oprica, Roxana Strungaru-Jijie	Synthesis, Characterization and Catalytic Efficiency of Biogenic AgNPs Derived from Artemisia absinthium
P-20.	Daniel Marconi, Alia Colniță, Andra-Sorina Tătar, Ioana Brezeștean, Nicoleta Elena Dina	NIL-Fabricated Flexible 3D Nanotrenches as Tunable Substrates for High-Performance SERS Analysis
P-21.	Daniel Marconi, Alia Colniță, Andra-Sorina Tătar, Nicoleta Elena Dina, Ioana Brezeștean	Portable SERS-based Platform for Sensitive Detection of Biotoxins in Freshwater Systems
P-22.	Paula Tosa, Romulus Puscas, Ariana Raluca Magdas, Maria David, Alexandru Nicolescu, Cristian Chisbora, Gabriela Cristea, Maricel Bocaneala, Dana Alina Magdas	Optimization of Water Extraction for Isotopic Analysis: Comparison between Centrifugation and Cryogenic Distillation
P-23.	Razvan Ghiarasim, Catalina-Nicoleta Basoc, Cristina Ciobanu, Rares-Ionut Stiufiuc, Brindusa Dragoi	Microfluidic Approach for Size-Controlled Liposomes Loaded with Doxorubicin Using Passive and Active Loading

P-24.	Vera Balan, Mirela Nistor, Camelia-Mihaela Zara-Danceanu, Nicoleta Basoc, Rares-Ionut Stiufiuc, Brîndușa Dragoi	The Interaction of Transition Metal-Doped Magnetic Nanoparticles with Plasma Proteins
P-25.	Paula-Vasilichia Bulieris, Claudia Lar, József-Zsolt Szücs-Balázs, Cristina Marcu, Stelian Radu, Maricel Bocaneala, Codruta Varodi	^{15}N-Isotopic Labeling of Arthrospira platensis for Advanced Metabolic Tracers: Analytical and Biophysical Optimization
P-26.	Codruta Varodi, Ancuta Balla, Claudia Lar, József-Zsolt Szücs-Balázs, Cristina Marcu, Stelian Radu, Gheorghe Marin	Sustainable Electrochemical Platforms Based on Stone Paper and Modified with Activated Coffee Waste Biochar for Advanced Analytical Sensing
P-27.	Melinda David, Monica Florescu, Camelia Bala	Eco-friendly Nanomaterials Towards the Specific Detection of "Forever Chemicals"
P-28.	Christina Zalaru, Maria Marinescu, Ioan Calinescu, Adina Gavrila, Rodica Tatia, Caludia-Valentina Popa, Isabela Tarcomnicu, Adrian Gainar, Anca Rosca	Comparative study of the isolation of quercetin from blueberry leaf and onion leaf
P-29.	Christina Zalaru, Florea Dumitrascu, Constantin Draghici, Maria Marinescu, Rodica Tatia, Matei Roibu, Alexandra Enciu, Stefania Radulescu, Bianca Cioara, Bianca Tudor	Design and Synthesis of Novel Antitumor Pyrazole Heterocyclic Dyes
P-30.	Michał Świetlicki, Kamil Jonak, Lidia Ślusarczyk, Karolina Siedliska, Beata Podkościelna, Andrzej Górecki, Arkadiusz Paweł Matwijczuk	Dual Fluorescence Of 1,3,4-thiadiazole Derivatives Confined In Polymeric Films: A Supramolecular Perspective
P-31.	Maria Marinescu, Alexandru-Cosmin Băloi, Eliza Oprea, Christina Zalaru, Claudia Valentina Popa	A DFT–Based Study and ADMET Evaluation of Small Heterocyclic Compounds with Antimicrobial Activity
P-32.	Alexandru-Cosmin Băloi, Maria Marinescu, Eliza Oprea, Christina Zalaru, Luiza Ana Maria Ştirbu, Georgiana Ramona Ştirbu, Teodora Radu, Anamaria Hanganu, Claudia Valentina Popa	Synthesis, ADMET Evaluation and Antibacterial Activity of Selected Pyrimidine Compounds
P-33.	Bogdan-Florin Craciun, Adina Coroaba, Narcisa-Laura Marangoci	Green-Fluorescent Carbon Dots Based on Protocatechuic Acid and Branched PEI for in vitro Imaging and Gene Delivery
P-34	Michela Corsini and Stefania Mitola	Exploiting the CAM assay as a rapid in vivo preclinical platform for tumor modeling
P-35.	Ioana Daniela Dulama, Cristiana Radulescu, Raluca Maria Stirbescu, Andreea Laura Banica, Ioan Alin Bucurica	Heavy metals in soil and Vitis vinifera L. – Assessment of the impact on human health

P-36.	Adriana Dehelean, Dana Alina Magdas, Gabriela Cristea, Ioana Feher	Assessment of the nutritional quality of infant complementary foods in Romania and their contribution to mineral intake
P-37.	Adriana Dehelean, Dana Alina Magdas, Maria David, Ariana Raluca Magdas, Alexandra Tabaran, Dan Sorin Daniel, Florina - Dorina Covaciu	Risk assessment of polycyclic aromatic hydrocarbons and potentially toxic elements in traditionally smoked meat
P-38.	Cezara Voica, Ioana Feher, Olivian Marincas, Gabriel Gati	Risk analysis of heavy metals contamination in riverine fish from Aries River, Romania
P-39.	Florina-Dorina Covaciu, Csilla Molnár, Cezara Voica	Human health risk evaluation in potatoes from Romania
P-40.	Cezara Bucataru, Irina Schiopu, Isabela Dragomir, Alina Asandei	Nanopore Electrophysiology Reveals Spatial Determinants of Hg^{2+} - Induced DNA Self-Duplexes
P-41.	Claudia Valentina Popa, Vladimir Suhaianu, Diana-Mihaela Popescu, Cristina-Anca Secara, Maria Marinescu, Christina-Marie Zalaru, Lucia-Elena Ionescu	Novel Carbopol Based Hydrogel with Antibacterial Activity for Burn Therapy
P-42.	Tecla Dulgheriu, Laura Ursu, Narcisa-Laura Marangoci, Alexandru Rotaru	Dextran-Based Preparation of Hybrid Gold-Magnetic Nanoparticles for SERS Detection of Environmental Contaminants

Oral Communications

Keynote talks

K-1. Fast dielectrophoretic, AI image analysis enabled sorting of single cells in a microfluidic system

Erik Beckert[1], Norbert Dnz[1], Michael Schmueck-Heneresse[2], Falk Kemper[1], Sarah Schulenberg[2], Neus Godino[3], Volker Bruns[4], Thomas Schoenfelder[1], Michaela Benz[4], Felix Pfisterer[3], Tobias Gerling[3], Julia Hetzel[4], Rosalie Kletzander[4], Michael Kirschbaum[3]

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Continuous flow, single cell sorting based on image analysis of morphologic cell features is a versatile concept that exploits spatially resolved items in cells for sorting them. Most of the academic and industrial systems published so far are complex, offer limited image quality and have a re-du-ced imaging modality. We present a medium complex microfluidic cart-ridge, and an add-on that allows any microscope to be turned into an image-activated cell sorter capable of sorting cells by previously in-acces-sible morphological features in cells. The cells are handled directly by negative dielectrophoresis (DEP) forces in a double-pass microfluidic layout, and at a sample volume through-put of ca. 1 µl/min, utilizing low flow velocities around 1 mm/s, enabling fluores-cence based imaging, AI-based sorting, and reduced shear stress on cells.

K-2. Is mass photometry a new gold standard for mass measurement

Bertrand Raynal

Plateforme de Biophysique moléculaire, Institut Pasteur, Université Paris cité, 25 Rue du Docteur Roux, 75015 Paris

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Mass photometry (MP) is a powerful, label-free optical technique used to measure the mass of individual particles in solution. This light-scattering method measures molecular masses in the 30 kDa–5 MDa range and provides mass distributions of different species by molecular counting. Over the years, it has become an essential tool for characterizing biomolecules in structural studies. One requirement of the measurement is that calibration must be performed with macromolecules that have the same partial specific volume and refractive index as the macromolecule of interest. Protein calibrants are fully accessible and well suited for measuring the stoichiometry of single proteins and protein–protein complexes. However, finding good calibrants for all types of macromolecules and complexes (DNA, carbohydrates, lipids, glycoproteins, lipoproteins, protein–DNA complexes, and membrane proteins in detergents or nanodiscs) is not an easy task. For such systems, suitable calibration procedures are lacking, making measurements inaccurate.

In this study, we demonstrate how calibration curves can be improved by introducing new ways to assess their quality and accuracy. We also provide protocols to obtain better calibrations. Moreover, we show how a universal calibration can be created to measure any type of macromolecule or complex in solution using simple protein standards.

K-3. The integration of data from multiple sources to enhance the capabilities of food recognition models

Dana Alina Magdas[1], Ariana Raluca Magdas[1], Maria David[1], Adriana Dehelean[1], Nastasia Belc[2], Gabriel Sorin Mustațea[2], Denisa Eglantina Duță[2]

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Due to the substantial natural variability, inherent in food products, and the introduction of items into the market that have undergone numerous subtle and challenging-to-detect adulteration processes, establishing reliable strategies for identifying counterfeits presents a continuous challenge. This endeavour requires a substantial amount of reliable experimental data that cannot be further processed solely through human processing capabilities. As a result, the application of supervised statistical tools and, artificial intelligence in the development of dependable instruments for detecting sophisticated adulterations has become a vital strategy. The increasing demand for these data processing methods is closely associated with the recent trend towards the adoption of rapid and environmentally friendly techniques.

Apart from this, bringing together data from several sources, through data fusion strategies, proved to be an effective way to increase the prediction of the recognition models. For this purpose, data collected based on distinct analytic techniques were brought together to refine the classification capabilities of the developed models. Three case studies will be discussed, related to i) wine differentiation based on ^{1}H-NMR and Raman spectroscopy, ii) honey recognition using IR and Raman spectroscopy, and iii) black pepper based on stable isotope ratios, elemental profiles, and IR spectroscopy. The resulting models exhibited exceptional classification performance, achieving accuracy levels of up to 100% in both cross-validation and testing, with the fused data surpassing the performance of single-technique inputs.

Acknowledgements: ”This work was supported by a grant of the Ministry of Education and Research, CCCDI - UEFISCDI, project number PN-IV-P6-6.1-CoEx-2024-0025, within PNCDI IV”

K-4. Multiple Roads to Fold: Modular Assembly of a Class A β-Lactamase Monitored by High-Resolution Hydrogen-Deuterium Exchange

Romain Malempré[1], Julie Vandenameele[1], Caroline Montagner[1], Christina Redfield[2], Christian Damblon[3], Gabriel Mazzuchelli[3], Sébastien Brier[4] and André Matagne[1]

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Class A β-lactamases, with their complex architecture and significant size (*ca.* 29 kDa), provide an excellent model for studying key features of protein folding. These enzymes exhibit two particularly interesting structural aspects: the formation of a β-domain in which the β-sheet is assembled from strands contributed by the N- and C-terminal regions of the polypeptide chain, and the distinctive packing of a large Ω-loop on the protein surface. While protein folding studies have traditionally focused on smaller, single-domain proteins with simple folding kinetics, β-lactamases enable the exploration of folding intermediates and alternative pathways in larger systems. Using *Bacillus licheniformis* BS3 β-lactamase as a model, we have elucidated the folding process by combining quenched-flow hydrogen/deuterium exchange pulse-labelling with high-resolution methods including 2D-NMR and proteolytic fragmentation mass spectrometry. Together, these approaches track the formation and stabilization of secondary structure elements over time and reveal kinetically populated folding intermediates. BS3 β-lactamase is particularly well suited for such studies due to its high solubility and stability, ease of purification, measurable biological activity, and well-characterized 3D structure at 1.7 Å resolution. The availability of an assigned ^{1}H-^{15}N HSQC NMR spectrum further supports detailed kinetic and structural analyses, providing new insights into folding pathways and intermediate states in larger, multidomain enzymes.

K-5. Multiscale nanomechanics of biological systems revealed by bioAFM

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The accumulation of reactive carbonyl species is a hallmark of several pathological states, including diabetes and aging. Methylglyoxal (MGO) is a highly reactive dicarbonyl that glycates proteins, leading to the formation of advanced glycation end products that alter protein function. While glycation-induced stiffening of extracellular and cytoskeletal structures is well-established, its impact on the physical properties of the nucleus remains poorly understood. Here, we combine atomic force microscopy with correlative confocal imaging to determine how MGO affects nuclear mechanics across scales. In isolated nuclei, MGO increases stiffness, reduces fluidity, and limits internal rearrangements during force application. Perturbation experiments further show that both lamin A/C and chromatin contribute to this stiffening response. In cultured cells, nuclear stiffening persists after actin depolymerization and is retained in nuclei isolated from MGO-treated cells. This is accompanied by increased YAP nuclear localization in a substrate-dependent manner, linking glycation-induced nuclear stiffening to altered mechanosensitive signaling. Extending these findings in vivo, nuclei from diabetic mouse hearts show increased stiffness that correlates with the level of MGO-derived adducts. Strikingly, this coupling between glycation burden and nuclear stiffening is conserved across isolated nuclei, cultured cells, and in vivo tissue. Together, these findings identify the nucleus as a mechanical target of metabolic stress and establish carbonyl damage as a direct mechanism linking metabolic dysfunction to altered force sensing.

K-6. VEGFR2-driven extracellula matrix remodeling sustains tumor growth

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Aberrant activation of VEGFR2 is a key driver of tumor progression through extensive remodeling of the extracellular matrix (ECM) and disruption of vascular function. By integrating two complementary studies, we show how oncogenic VEGFR2 reshapes the tumor microenvironment via coordinated biochemical and biomechanical mechanisms. A multi-scale technological approach was used to characterize ECM remodeling. Label-free Second Harmonic Generation (SHG) imaging, combined with optical clearing and 3D reconstruction, enabled quantitative analysis of collagen organization and fiber anisotropy. These structural data were integrated with transcriptomic profiling and quantitative proteomics (LC-MS/MS), revealing widespread alterations in matrisome composition, ECM-remodeling enzymes, and growth factor signaling. To functionally dissect ECM-driven effects, decellularized ECM (dECM) platforms were employed as biomimetic substrates. VEGFR2-mutant ECM increased tumor cell fluidity and metabolic activity, while profoundly altering endothelial cell behavior. Endothelial cells exposed to mutant ECM displayed defective adhesion dynamics, cytoskeletal reorganization, and impaired morphogenesis. Mechanobiology approaches further uncovered the functional consequences of ECM remodeling. Particle Image Velocimetry (PIV) quantified tissue fluidity, while FRET-based biosensors measured focal adhesion tension and kinase activity. Microfluidic shear stress assays revealed impaired endothelial mechanosensing, leading to defective polarization, disrupted VE-cadherin junctions, and activation of endothelial-to-mesenchymal transition (EndMT). In vivo xenograft models and 3D spheroids, combined with pharmacological inhibition (e.g., lenvatinib), showed that VEGFR2 blockade partially restores ECM architecture and vascular stability. Overall, this integrated framework identifies VEGFR2-driven ECM remodeling as a central regulator of tumor–stroma–endothelium crosstalk and a promising therapeutic target

K-7. Microfabrication for Cell Membrane Mimetics

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Droplet Interface Bilayers (DIBs) are formed at the contact zone between two lipid-monolayer-coated aqueous droplets in oil. This geometry offers precise control over bilayer composition, geometry, and access to both leaflets. We have exploited this to develop a platform combining simultaneous single-molecule fluorescence imaging and single-channel electrophysiology, enabling correlated structural and functional measurements of membrane proteins that are inaccessible by either technique alone.

Taking DIB technology further, we have used digital microfluidics (DMF) to address a central challenge in synthetic biology: engineering artificial cells capable of self-replication. Rather than reconstituting the biochemical machinery of biological cell division, we use DMF to directly orchestrate DNA replication and compartment division as separable, controllable processes. This approach allows precise coupling of these two fundamental events, and we demonstrate controlled cycles of replication and division in which daughter compartments inherit parental DNA, maintaining genetic continuity across multiple generations.

By replacing biochemical complexity with direct physical manipulation, this system provides a minimal, transparent testbed for interrogating the essential requirements for self-replication. Together, these results illustrate how microfabrication approaches can bridge biophysical measurement and the construction of life-like systems from the bottom up.

K-8. Scattering-type scanning near-field optical microscopy: Architectural Developments, Applications and Data-Driven Approaches

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Scattering-type scanning near-field optical microscopy (s-SNOM) is a powerful nanoscale imaging and spectroscopy technique capable of probing local optical and physicochemical properties beyond the diffraction limit. In this invited talk will present recent advances in s-SNOM instrumentation, multimodal imaging, and data-driven analysis, with emphasis on applications in biomedical engineering, biomaterials, and complex biological systems.

The presentation will briefly introduce the operating principles of s-SNOM and representative experimental implementations, highlighting applications in nanostructured and hybrid materials together with quantitative retrieval of local optical parameters. Particular attention will be given to correlative imaging approaches integrating s-SNOM with complementary optical microscopy techniques, including confocal and nonlinear microscopy, enabling simultaneous nanoscale chemical contrast and larger-scale structural information relevant to biological interfaces and cellular environments.

Recent developments in probe engineering, nanolithography, and artificial intelligence-assisted near-field microscopy will also be discussed. Examples will include accelerated spectral analysis, predictive modelling, and inference of nanoscale optical responses from complementary imaging data. Overall, the talk will illustrate how the integration of advanced instrumentation, multimodal imaging, and AI-enhanced methodologies is expanding the role of near-field optical nanoscopy in biophotonics, nanomedicine, and biofunctional materials research.

Acknowledgments: SGS acknowledges the financial support of UEFISCDI Grants: PN-IV-P7-7.1-PED-2024-2374 (POLYNANO); PN-IV-PCB-RO-MD-2024-0541 (OPTOCARSEMO); PN-IV-P8-8.3-PM-RO-TR-2024-0068 (CONAGAI)

K-9. Application of HPLC-HR-MS for the Characterization of Bioactive Compounds in Encapsulated Plant-Based Ingredients

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Sample treatment for the analysis of bioactive compounds by HPLC-MS in encapsulated formulations involves essential preparative steps to release and extract analytes from complex matrices. This process is critical for assessing encapsulation efficiency, drug release, and regulatory compliance. Sample treatments must be tailored to the specific formulation type to ensure method sensitivity and accuracy by HPLC-MS.

For spray-drying, powders are reconstituted in solvents like water or methanol, often aided by vortexing or sonication. Similarly, protocols for freeze-drying formulations utilize rehydration and solvent extraction to enhance recovery.

Moreover, emulsions require demulsification using organic solvents or surfactant removal agents, followed by liquid-liquid extraction to isolate analytes prior to analysis.

Ionic gelation matrices are disrupted using chelating agents like EDTA or sodium citrate to break ionic cross-links, followed by filtration to prevent instrument clogging. Similarly, hydrogels involve swelling in solvents or enzymatic digestion to facilitate the release of target compounds, often combined with multi-step solvent extraction.

To mitigate matrix effects such as ion suppression, strategies could include solid-phase extraction, dilution, and the use of appropriate internal standards. In addition, cleanup via centrifugation or filtration remains a standard requirement across all methods to remove insoluble excipients. Integrating these tailored disruption and extraction workflows is fundamental for the accurate quantification of bioactives in diverse delivery systems.

Grant C-CTS-080-UGR23 funded by Consejería de Universidad, Investigación e Innovación and by ERDF Andalusia Program 2021-2027.

K-10. The triple challenge in honey authentication: dynamic datasets, novel markers and screening strategies

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The beekeeping sector is increasingly challenged by climate change, pesticide exposure and rising production costs. At the same time, food fraud represents a major concern, with mislabelled and adulterated honey circulating on the European market, highlighting the need for robust analytical solutions.

A key challenge lies in the establishment of comprehensive and dynamic datasets capable of defining reference variability ranges for authentic honey. These datasets must account for compositional fluctuations driven by climatic conditions, geographical origin, and production year. A critical limitation remains the collection of authentic samples, as undeclared and non-permitted artificial feeding can alter honey composition and compromise dataset reliability, thereby underscoring the need for rigorous sampling strategies.

In parallel, the identification of novel biochemical markers remains essential for the accurate determination of botanical origin, particularly for region-specific honeys. The exploration of less investigated fractions, such as lipids, may offer new opportunities for improving authentication approaches.

Finally, the development of effective screening strategies is crucial for large-scale fraud detection. Although techniques such as NMR and MS provide high analytical accuracy, their cost and time requirements limit their routine application. Portable spectroscopic tools (e.g., FT-NIR), combined with machine learning approaches, represent a promising and scalable alternative.

This contribution highlights the efforts of the Food Analysis Lab, University of Verona, in providing new authentication approaches for honey through the development of representative datasets, the identification of novel markers, and the implementation of rapid, scalable screening strategies.

K-11. Deep Learning Architectures for Precision Oncology

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Precision oncology combines tumour biology with patient-specific clinical data to enable early cancer detection, targeted intervention, or active surveillance of advanced disease. Recent advances in artificial intelligence (AI), particularly deep learning, exploit high-dimensional, multimodal data to uncover subtle, disease-specific patterns, while also modelling inter-patient variability. These methods can be deployed across the entire clinical data pipeline, from data pre-processing and representation learning to predictive modelling and decision support. Using representative case studies, this work demonstrates an end-to-end perspective on the application of modern AI architectures for cancer detection and characterisation across multiple data modalities.

The first case study addresses data pre-processing, focusing on deep learning-based image segmentation, with prostate gland segmentation in magnetic resonance imaging (MRI) as a representative task. Although accurate gland delineation is a prerequisite for computer-assisted diagnosis, treatment planning, and radiotherapy, it remains challenging due to anatomical variability and poorly defined boundaries. To alleviate this problem, we propose a U-Net-based framework with a hybrid loss function that improves contour accuracy and robustness, thereby enabling reliable extraction of quantitative MRI features for downstream risk stratification and multimodal data integration. The second case study examines downstream representation learning and decision support, focusing on the identification of circulating tumour cells (CTCs) from imaging flow cytometry as a minimally invasive liquid biopsy. Visual transformer-based models and attention-augmented convolutional neural networks integrating biological metadata demonstrate improved detection accuracy and reduced false positives. Together, these studies highlight interpretable, scalable AI frameworks with strong translational potential in precision oncology.

K-12. How Far Can Liquid State NMR Spectroscopy Take Us In Studying Peptide-Liposome Formulations?

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Liposomes constitute attractive biocompatible drug delivery systems for peptide drugs, enabling a controlled release of pharmaceutical ingredients. While NMR spectroscopy is an essential technique to characterize molecular structure and dynamics in chemistry as well as in structural biology, its full potential to analyze physicochemical properties of drug-liposome formulations remains underexploited. In this study, we explored multiple facets of liquid-state NMR spectroscopy to characterize liposomal delivery systems for an apelin-derived peptide and an acetylated analogue, which hold therapeutic promise for cardiovascular diseases. We systematically examined various liposome compositions and preparation modes. Using NMR, in combination with size measurements by dynamic light scattering and cryo-electron microscopy, we determined structural, dynamic and self-association properties of these peptides in solution, and probed their interactions with liposomes. We characterized membrane fluidity and thermotropic phase transitions in both empty and peptide-loaded liposomes by 31P and 1H NMR. Based on diffusion ordered spectroscopy, we were able to localize and to quantify peptides within the inner and the outer spaces of liposomes. We further tracked changes over time and upon thermal treatments. Finally, we assessed the release kinetics of several solutes. Collectively, our findings demonstrate that NMR spectroscopy can serve as a central analytical platform for the rational design of peptide-liposome formulations and, more generally, advanced drug delivery systems (Doyen et al., Molecular Pharmaceutics 2021).

We are grateful to Eric Larquet (Ecole Polytechnique, Palaiseau, France) for conducting cryo-EM experiments. This work was supported by the IR INFRANALYTICS FR2054 and the French Infrastructure for Integrated Structural Biology (FRISBI) ANR-10-INBS-0005.

K-13. Advanced Magnetic Materials: From Ferromagnetic Shape Memory Alloys to Smart Biomaterials Functionalities

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Ferromagnetic shape-memory alloys are emerging as a promising platform for developing adaptive smart biomaterials due to their unique combination of properties. First, magnetic fields can induce reversible mechanical responses without direct contact, enabling controlled stimulation of tissues surrounding an implant. Second, magnetic actuation enables remote adjustment of the implant's shape and function during implantation and long after insertion, opening new avenues for dynamic, personalized medical treatments. Third, ferromagnetic shape-memory alloys retain key features of traditional shape-memory materials, such as pseudoelasticity.

The lecture will highlight a major shift in the field: from basic smart magnetic responses to true smart biomaterial functions. This shift requires advanced magnetic materials that combine responsive mechanical properties, corrosion resistance, biocompatibility, and effective interaction with cells and blood. Some ferromagnetic shape-memory alloys have already demonstrated promising support for cell growth, while surface functionalization with peptide or polymer coatings can further enhance their anti-thrombogenic and biointeractive features. These materials connect magneto-mechanical functionality with biointerface engineering and point toward a new generation of implantable materials that actively interact with living systems rather than simply replacing damaged structures. Complete characterization of biomaterials requires a multimodal approach, combining preparation methods with analytical techniques to evaluate composition, structure, and thermal and mechanical properties, and nanoanalytical methods to study surface chemistry, nanoscale topography, and local interactions that influence biological responses.

K-14. Engineering a Pore-Forming Protein for Efficient Discrimination of Medically Important Proteins

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The complex structures, remarkable stability, and broad diversity of natural pore-forming proteins (PFPs) have inspired their application across a wide range of biotechnological fields. Label-free single-molecule nanopore sensing is based on detecting ionic current flowing through a biological nanopore embedded in an electrically insulating lipid or synthetic membrane. When electroosmotic and electrophoretic forces promote analyte translocation through the nanopore, characteristic transient current blockades are generated. In optimized systems, these blockade signatures are analyte-specific, enabling discrimination even within complex samples. Following the success of nanopore DNA sequencing as a powerful third-generation sequencing technology, nanopore-based protein detection (protein fingerprinting) and amino acid sequencing have attracted increasing attention.

Achieving efficient protein detection at single-amino-acid resolution requires the development of new nanopores with tailored dimensions and biochemical properties. Particularly promising are nanopores that insert stably into artificial membranes and support high-throughput detection of medically relevant proteins. Our research focuses on pore-forming toxins (PFTs), especially actinoporins and actinoporin-like proteins. Using structural biology approaches, we determine the structures of engineered nanopores and apply conventional genetic engineering strategies to optimize their sensing performance. Our efforts include enhancing stable membrane insertion, reducing pore gating and noise, and improving overall sensing characteristics. We also investigate the incorporation of unnatural amino acids into the pore-sensing region, which may further expand the analytical capabilities of these systems. We will present our recent work on the development of a protein nanopore derived from the coral Orbicella faveolata for the detection of positively charged proteins, such as histones.

K-15. Bioinspired Nanopore Sensors for Probing Transient Molecular Hallmarks in Neurodegeneration

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A GGGGCC hexanucleotide repeat expansion in the open reading frame 72 of chromosome 9 is the most prevalent genetic cause of amyotrophic lateral sclerosis (ALS) and frontotemporal dementia (FTD; C9-ALS/FTD). In recent years, significant progress has been made in understanding the mechanism of neuronal damage, driven by the aberrant accumulation of unnatural dipeptide repeat (DPR) polypeptides in patients' brains. A major challenge to advancing therapeutic approaches for ALS/FTD pathologies is the lack of high-resolution techniques for detecting early RDPR aggregation. In this talk, I will present our recent progress in developing a protein nanopore sensor for single-molecule detection of RDPR aggregates at their earliest stages, before phase-separating conditions. We recently engineered a single polypeptide chain nanopore that accommodates many negative charges within its lumen. This platform enables detection of highly positively charged RDPR monomers and small oligomers through a nonspecific interaction mechanism for these intrinsically disordered polypeptides. This sensing platform, along with complementary ensemble techniques, shows promise for further studies to uniquely profile the kinetics and dynamics of RDPR oligomer formation and neurotoxic phase separation in these pathologies.

K-16. Functional Peptides: From Design and Synthesis to Biomedical Applications

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Functional synthetic peptides offer a versatile platform for biomedical innovation, supporting applications in membrane penetration, supramolecular assembly, therapeutics, and diagnostics. We present complementary studies on short peptides synthesized via Fmoc/tBu solid-phase peptide synthesis and validated by high-resolution mass spectrometry and, when required, HPLC purification.

Cell-penetrating homing peptides, such as tLyP-1, show strong potential in cancer diagnosis and therapy due to their dual ability to bind overexpressed receptors and deliver cargo across membranes. Using model lipid membranes and confocal microscopy, we demonstrate that peptide penetration is strongly influenced by membrane composition. Molecular dynamics simulations of tLyP-1 and its fluorophore-labeled analogue embedded in POPC bilayers further reveal distinct interaction modes and mechanistic insights into membrane translocation.

In parallel, we developed peptide substrates for multiplex enzymatic diagnostics of rare lysosomal storage disorders. Using MRM-MS and fluorimetry, we achieved sensitive detection of enzymatic activities associated with three neuronal ceroid lipofuscinoses (NCLs) in dried blood spots.

Acknowledgments

The present study was financially supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI–UEFISCDI, project number PN-IV-P1-PCE-2023-0678.

K-17. Recent advances in wearable and implantable artifical kidney and global collaborations towards commercialization

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This paper explore and delve into the current global advances in wearable and implantable artificial kidney. The technology behind each of the current advances will be covered, along with the global collaboration in technical development and clinical trials, in effort to bring the device to market. Other bridging technical aspects such as device certifications, national and international standards involved and market validation in real patient environments will also be covered. The talk will review dialysate regeneration, chip-based nanoporous hemofilters and peritoneal-based artificial kidney technologies. In the near future, hemodialysis (HD) and peritoneal dialysis (PD) will remain as the important modalities for end-stage renal disease (ESRD) patients' treatment, as only a small percentage of patients is suitable for kidney transplant, and xenotransplantation, 3-D bioprinted and laboratory-cultivated kidneys are still in early research and implementation stages. A major breakthrough in kidney replacement therapy (KRT) in the near future would be on mobile, affordable and easy to use dialysis systems. The migration from conventional kidney transplantation and conventional hemo- and peritoneal dialysis would be in form of portable miniaturized hemodialysis system, wearable peritoneal dialysis system, implantable dialysis filter, and ultimately implantable fully functional mechanical artificial kidney. Globally, three types of wearable peritoneal dialysis systems are currently in human clinical trials: AWAK (Automated Wearable Ambulant Kidney), Weakid peritoneal dialysis device (Nanodialysis) and PeritoCare® portable dialysis system.

PeritoCare® is a portable peritoneal dialysis system developed by Universiti Kebangsaan Malaysia, equipped with various sensors and designed for mobility. During human clinical trial, 82% of the tested patients approved and strongly agreed to use PeritoCare® in the future for their dialysis treatment. PeritoCare® received Malaysian Medical Device Authority (MDA) full certification on 30th June 2023.

K-18. Electrochemical Microbiosensors for Real-Time Neurochemical and Redox Monitoring in Living Tissues

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Understanding fundamental mechanisms involved in the progression and development of diseases is of great physiological and pathological importance. Such studies require the availability of effective methods to probe biochemical processes in real time and allow accurate detection and quantification of biomarkers and mediators of injury. Study of the role and mechanism of action of these mediators is also critical to develop therapies and assess pharmacological effects. However, the presence of these chemicals at very low concentrations and variable levels and the complexity of the biological environment pose a great challenge for their detection. Using custom designed microelectrodes, electrochemistry provides unique opportunities to detect reactive species in living tissues, providing direct and real time evidence of reactive oxygen (ROS) levels with high spatial resolution. This presentation will discuss our efforts to fabricate microbiosensing platforms for investigating fundamental physiological and biochemical mechanisms in vivo and in vitro, particularly those associated with neurochemical monitoring and with ischemia and reperfusion injury. The influence of the microelectrode design parameters including surface coatings and electrode size, and the ability of the sensor to obtain quantitative spatial and temporal analytical data of the release and distribution of oxidative stress markers will be provided with examples of applications. Advantages and limitations of these systems for measurements in real biological environments will be discussed. Our results demonstrate the potential of electrochemical techniques to generate information about biomarkers and obtain fundamental biochemical-relevant information on physiology, metabolism and disease states in living systems.

K-19. Multiplexed Label-Free Electrochemical Immunosensing for Rapid Diagnosis of Cancer and Neurodegenerative Disorders

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In this plenary talk, we present a new generation of disposable, nanostructured electrochemical immunosensing platforms designed for the ultrasensitive and simultaneous detection of clinically relevant biomarkers for both cancer and neurodegenerative disorders. These platforms integrate advanced nanocomposites, including metal molybdates, MXene-based hybrid nanostructures, and metal oxide-carbon nanotube systems, with conductive polymers to enhance surface area, electron transfer, and antibody immobilization efficiency. The resulting label-free impedimetric biosensors demonstrate exceptional analytical performance, achieving femtogram-level detection limits and wide linear dynamic ranges for multiple protein and nucleic acid targets.

For breast cancer diagnostics, dual- and multiplexed immunosensors were successfully developed for biomarkers such as CEA, HER2, and MUC1, alongside a highly sensitive lab-on-chip platform targeting BIRC5 mRNA. These systems exhibit excellent selectivity, reproducibility, and stability, with strong performance in clinical sample analysis, highlighting their potential for early-stage cancer detection and real-time disease monitoring.

Extending this approach to neurodegenerative disorders, we explore multiplexed sensing strategies for key blood-based biomarkers of Alzheimer's disease, including amyloid-β isoforms (Aβ40, Aβ42), tau proteins (total and phosphorylated forms), and neurofilament light chain. Given the ultra-low concentrations and complex interplay of these biomarkers, simultaneous detection on a single platform significantly enhances diagnostic accuracy and enables earlier disease identification, even prior to clinical symptom onset.

This talk will highlight the transformative potential of multiplexed, label-free electrochemical biosensors as portable, cost-effective, and highly sensitive diagnostic tools. By enabling comprehensive biomarker profiling in a single assay, these platforms pave the way toward next-generation point-of-care diagnostics for both oncology and neurodegenerative disease management.

Keywords: Multiplexed biosensing; Label-free electrochemical detection; Cancer biomarkers; Alzheimer's disease biomarkers; Nanostructured immunosensors

Oral Communications

Invited early researcher talks

I-1. Deciphering the Fibrillation Pathway and Determinants of Paramyxovirus P/V/W Proteins: a Dialogue Between Experimental and Computational Biophysics

Julien Mignon[1], Harshita Sawdekar[1,2], Frank Gondelaud[1], Sonia Longhi[1]

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Paramyxoviruses, such as Hendra (HeV) or Nipah (NiV), are high-priority lethal zootonic pathogenic targets responsible for fatal neurological and respiratory diseases across Asia and Australia. Their genome encodes virulence factors, such as the W protein of HeV (W^{HeV}) which was shown to aggregate into amyloid-like fibres primarily via its N-terminal PNT1 domain. Whilst such a unique molecular behaviour is sparsely reported in viruses, it is likely relevant to pro- or antiviral activity in host cells. Furthermore, recent works have experimentally pinpointed the main fibrillation driver of PNT1: a 10-residues long cryptic amyloidogenic region (CAR) remarkably conserved across the *Henipavirus* genus. Mechanistically, CAR is expected to undergo a disorder-to-order transition over the course of W^{HeV} fibrillation with the help of a C-terminal flanking region characterised by an inherent α-helical propensity. However, their interplay during nucleation and the molecular basis governing their structural rearrangement into β-sheeted species remain uncharted, hence curtailing our understanding of W^{HeV} amyloid pathway. To overcome such limitations, we exploited a combined experimental-computational methodology that takes advantage of spectroscopy and microscopy coupled with all-atom molecular dynamics simulations. We deciphered the amino acid alphabet of PNT1 N-terminal motifs as well as their conformational dialogue that not only favour the stabilisation of polymorphic cross-β precursors but also drive the protein self-assembly for fibrillar nucleation and elongation. By underpinning previous reports, such integrated biophysical approach expands our comprehension of viral amyloids, while holding promise for the design of new antiviral strategies targeting aggregation prone regions in viral proteins.

I-2. Optimization of Extraction Methods for Plant Analysis: Toward Efficient, Sustainable, and Selective Approaches

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The characterization of secondary metabolites, bioactive compounds, and contaminants in plant matrices is critically dependent on the efficiency and selectivity of the employed extraction procedure. While being well established, classical extraction techniques (e.g., maceration, infusion, or hydrodistillation) are often associated with high solvent consumption, lengthy processing times, and potential degradation of thermolabile analytes. The growing demand for greener, faster, and more reproducible analytical workflows has therefore driven significant research interest in the optimization and modernization of plant extraction methodologies.

By using alternative methods, such as enzymatic-assisted (EAE) and ultrasound-assisted extraction (UAE), several key parameters can be optimized: solvent composition, solid-to-liquid ratio, temperature, time, and ultrasonic parameters. In this presentation, multivariate optimization using response surface methodology and design of experiments frameworks are also presented as models enabling efficient exploration of the parameter space with a minimal number of experimental runs.

Illustrative experimental examples will be discussed: EAE and UAE approaches for aqueous extracts of fruits (Rosaceae) and UAE hydroethanolic extracts for aromatic plants (Lamiaceae). The applied optimized modern techniques outperform conventional approaches in terms of recovery rates and analytical throughput, while significantly reducing organic solvent usage in alignment with the principles of green analytical chemistry.

This paper was co-financed by the European Regional Development Fund (ERDF) through the Smart Growth, Digitization and Financial Instruments Program (PoCIDIF), call PCIDIF/159/PCIDIF_P1/OP1/RSO1.1/PCIDIF_A1.1, Project SMIS number 329011.

I-3. Proton-coupled excited-state pathways governing ultralong room-temperature phosphorescence in a coumarin luminophore

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Room-temperature phosphorescence (RTP)[1] in purely organic systems is limited by weak spin–orbit coupling and efficient non-radiative decay, making efficient triplet-state population a key challenge. The influence of proton transfer and tautomerism on excited-state dynamics remains poorly understood.

In this work, we investigate a 4-hydroxycoumarin derivative (16C [2]) as a model system exhibiting RTP, combining steady-state and time-resolved spectroscopy with quantum-chemical analysis. The compound shows intense fluorescence in solution, while immobilization in a rigid poly(vinyl alcohol) (PVA) matrix induces long-lived phosphorescence with lifetimes on the order of 10^{-1}–10^{0} s and a pronounced afterglow, consistent with restricted molecular motion and reduced non-radiative decay. DFT and TD-DFT calculations reveal that intersystem crossing occurs via coupling between a singlet excited state of mixed $\pi\pi^*$/charge-transfer character and low-lying triplet states of $n\pi^*$ nature localized on the carbonyl group. Importantly, the efficiency of these processes is governed by keto–enol tautomerism, with *the diketo* form providing favorable conditions for triplet-state population.

Overall, RTP in this system arises from proton-coupled modulation of electronic structure, enhanced by environmental rigidification. These findings establish a link between tautomeric equilibria and excited-state dynamics, providing a framework for designing metal-free organic phosphors with controllable emission properties.

[1] *Methods Appl. Fluoresc.* 2025, *13*, 015003, doi:10.1088/2050-6120/ad9885. [2] *Int. J. Mol. Sci.* 2025, *26*, doi:10.3390/ijms26147015.

I-4. Tailoring Plasmonic Nanostructures via Nanoimprint Lithography for High-Performance SERS

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Advances in surface-enhanced Raman scattering (SERS) detection method at the single-molecule level depend on the rational design and fabrication of improved plasmonic substrates capable of generating consistent Raman signals. A modern and effective approach to fabricate well defined SERS-active nanopatterns is nanoimprint lithography (NIL). This technique's unique capabilities have significantly streamlined the fabrication of plasmonic structures and their potential applications - particularly in the development of SERS substrates. Here, we present the NIL fabrication of flexible, three-dimensional plasmonic surfaces based on periodical nanostructures, which holds great promise for diverse applications ranging from neurodegenerative disease monitoring to environmental detection of biotoxins. Two distinct periodic nanostructure designs were employed: grating arrays of nanotrenches and network of nanopillars. We demonstrate that a fine tuning of their structural features can be achieved through controlled deposition of metallic (Au, Ag) or semiconducting (ZnO) thin films. This will drastically influence the plasmonic properties, notably enhancing the Raman signal amplification and lowering the detection limit to pM.

Acknowledgments: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CCCDI - UEFISCDI, project number PN-IV-P7-7.1-PED-2024-0052, within PNCDI IV. This work was also supported through the "Nucleu" Program within the National Research Development and Innovation Plan 2022–2027, Romania, carried out with the support of MEC, project no. 27N/03.01.2023, component project code PN 23 24 01 02.

I-5. From Juniper Biomass to Functional Electrochemical Interfaces: An Electroactivated MOF/Biochar Platform for Carbendazim Detection

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Driven by the valorization of sustainable natural resources, this work presents a novel electrochemical sensing platform constructed from juniper leaf biochar integrated with a metal–organic framework (MOF). The use of biomass-derived biochar reflects an eco-friendly approach, while the incorporation of MOF provides a highly porous structure and abundant active sites, leading to enhanced electrochemical performance. The resulting hybrid material was engineered as a functional interface for the sensitive detection of the pesticide carbendazim in food samples. To further improve the electrochemical response, the modified electrode was electroactivated using cyclic voltammetry, enabling efficient charge transfer and signal amplification. The developed sensor demonstrated excellent analytical performance, achieving a low detection limit of 4.9×10^{-9} M and a high sensitivity of 4.31 □ 10^{8} $A\cdot M^{-1}\cdot cm^{-2}$. The practical applicability of the platform was validated in real samples, including apple pulp, tomato pulp, and tap water, with recovery values ranging from 88% to 114%. These findings highlight the potential of transforming natural biomass into advanced functional materials for the development of efficient, sustainable, and high-performance electrochemical sensors.

Acknowledgments: A.D. gratefully acknowledge Pedro A. Salazar-Carballo and his team for their valuable support and for providing technical assistance in the characterization of the materials used in this work.

Oral Communications

Contributed talks

O-1. Bridging Electrical and Optical Signatures: A Unified Platform for Single-Cell Characterization

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We introduce a multifunctional experimental platform designed for detailed biophysical evaluation of individual living cells by integrating dielectrophoresis (DEP) with optical tweezers (OT) in a unified setup. This approach enables concurrent measurement of electrical and optical properties directly at the single-cell level, eliminating the need for labeling strategies, calibration particles, or substrate attachment. By moving beyond ensemble-based DEP techniques, the system captures intrinsic variability between cells that is otherwise masked in population-averaged measurements.

The method yields high-quality DEP responses from individual suspended cells, which are used to extract key dielectric parameters, including membrane and cytoplasmic conductivities as well as membrane permittivity. Simultaneously, the optical trapping component provides dynamic stiffness measurements, offering complementary insight into refractive index–related properties. The platform is compatible with cells exhibiting irregular geometries or internal complexity.

The platform is supported by a lab-made open-source software for automated imaging and synchronized data acquisition. Experimental validation was carried out using cells in culture. The electrical characteristics obtained at single-cell resolution were consistent with established bulk measurements, while optical trapping results aligned with independent force calibration methods. In addition, the system supports repeated probing of the same cell, enabling time-resolved studies under varying experimental conditions, like a cell membrane resealing after electroporation.

This flexible framework expands the capabilities of label-free single-cell analysis and creates new opportunities for applications in cell biology, biomedical diagnostics, and therapeutic development.

O-2. HoloPath – Intelligent Procedure based on Digital Holographic Imaging for Digital Pathology

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Digital Pathology integrates imaging technologies, data management and analytical methods (including Artificial Intelligence) to enhance diagnostic accuracy and workflow efficiency. Use of endogenous biomarkers for unstained samples is beneficial, reducing chemical exposure and time-to-diagnosis. We propose an intelligent procedure for grading unstained samples of colonic adenomas using Digital Holographic Microscopy (DHM), a non-invasive technique already validated in various clinical areas (haematology, oncology, infectious diseases, etc.). DHM provides quantitative phase maps (QPMs) of refractive indices of samples, correlated to local protein concentration.

HoloPath, a digital library of QPIs for 5 morphologies of colonic lesions was produced using DHM®-T1000 (Lyncée Tec, Switzerland) digital holographic microscope in transmission, in *off axis* configuration. A bright field microscopy reference library of standard histological images was collected from consecutive tissue sections of each tissue sample, having standard staining (H&E, Van Gieson, and immunohistochemistry).

Unsupervised algorithms (for identification histological structures) and supervised algorithms (for dysplasia grading, mapping of suspicious invasion/ desmoplastic/ inflammation areas, and score based diagnosis of malignant from benign or inflammation) were implemented using MLNet/Auto ML framework, until reaching an overall accuracy of 85% compared to the routine Pathology diagnosis. A Graphical User Interface was implemented in Matlab/Pyton for a facile integration of digital libraries and models in the Pathology clinical setup.

This procedure could be used for objective computer-assisted workflow in Pathology units, in conditions of large volumes of samples.

Acknowledgment: This work was supported by a grant of Romanian National Authority for Scientific Research, UEFISCDI, under research project 14PED/2025 PN-IV-P7-7_1-PED-2024-0511.

O-3. Quantitative Investigation of Cellular Anisotropy Using Polarization Digital Holographic Microscopy

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We apply polarization digital holographic microscopy (PDHM) to investigate birefringence in attached DC3F cells (Chinese hamster lung fibroblasts). PDHM provides quantitative phase and polarization-sensitive imaging, enabling spatially resolved mapping of optical anisotropy in biological samples without the need for labeling. The Jones matrix of the sample is extracted from the polarization-resolved holograms, allowing determination of local polarization properties, including amplitude and phase retardation. The results reveal the mean ratio of spatial variations in birefringence maps equal to 1.6 radians that correlate with cellular morphology and internal structural organization of fibroblasts.

Polarization state of biological samples is known to be insensitive to molecular chemistry, but it reveals the anisotropic organization of macromolecular structures within cells. While standard methods require multiple images taken with different orientations of birefringent optical components to determine polarization, our system retrieves the full polarization state in a single acquisition, making it faster and simpler.

Here we discuss the PDHM-based procedure to evaluate the birefringence of cells in culture.

Acknowledgments

The National Agency for Research and Development of Moldova (NARD) project under project number 25.80013.8007.01ROMD and 25.80012.5007.39TC

This work was supported by a grant of the Ministry of Education and Research, CCCDI-UEFISCDI, project number PN-IV-PCB-RO-MD-2024-0285, within PNCDI IV

O-4. Synthesis of silver nanoparticles using grape pomace extracts with superior visible light photocatalytic activity and evaluation of their effects on wheat (Triticum aestivum L.)

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In this study, a simple, cost-effective, and eco-friendly approach was developed for synthesizing silver nanoparticles (AgNPs) using white (Muscat Ottonel, WGPE) and red (Cabernet Sauvignon, RGPE) grape pomace extracts. The synthesized AgNPs were morphologically and physicochemically characterized by SEM, AFM, DLS, UV-Vis, FTIR, and XPS analyses. The NPs formation was detected by a color change to dark brown and confirmed by a surface plasmon resonance peak at 445 nm. The biosynthesized AgNPs were predominantly spherical, with variable size distributions, and stabilized by phytochemicals. The photocatalytic efficiency of both AgNPs was evaluated against methylene blue under visible light irradiation. Noticeably, WGPE-AgNPs showed the highest performance; 77% of MB was removed within 240 min at a constant rate of 0.0062 min-1, almost three times that of RGPE-AgNPs. Photodegradation was mediated by holes and hydroxyl radicals, and the NPs maintained their efficiency for three successive cycles. Furthermore, the impact of wheat (Triticum aestivum L.) seed priming with AgNPs (25 and 100 mg/L) on growth attributes, photosynthetic pigments, lipid peroxidation (MDA), and antioxidant enzymes (SOD and CAT) was evaluated after eight days. Priming with 25 mg/L WGPE-AgNPs for 24 h significantly enhanced wheat seedling growth and chlorophyll content compared with the control. Conversely, treatment with 100 mg/L RGPE-AgNPs induced oxidative stress, significantly reducing growth parameters. These results demonstrate that the biosynthesized AgNPs exhibit great potential for applications in both agriculture and environmental remediation.

Acknowledgments: This research was supported by the Ministry of Research, Innovation, and Digitization, CNCS-UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0258, within PNCI IV program.

O-5. Multi-analytical approaches applied for the authentication of spices and herbs

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Basil (Ocimum basilicum) is one of the most appreciated and widely used aromatic spices worldwide, with a continuously increasing demand due to its extensive use in Mediterranean cuisine, the food industry, and functional food products. Owing to its high demand, distinctive aromatic profile, and rich content of bioactive compounds, basil authentication and quality assessment have become essential for preventing food fraud and ensuring traceability and authenticity of commercial products.

In the present study, a multi-analytical approach based on inductively coupled plasma mass spectrometry (ICP-MS), isotope ratio mass spectrometry (IRMS), and vibrational spectroscopy (FT-IR, FT-Raman) was used to obtain comprehensive elemental, isotopic, and molecular fingerprints of basil samples. The investigated factors included growing regime (organic vs. conventional, pot vs. garden, greenhouse vs. field). By combining these methods with advanced chemometric analysis (PLS-DA), compositional variations related to environmental factors and fertilization practices were found. The $\delta^{15}N$ values are the best indicator of nitrogen sources and fertilization regimes, providing a reliable marker distinguishing organic and conventional production systems. Elemental profiles further reflected differences in soil composition and agricultural inputs, while FT-IR and FT-Raman spectra captured variations in the molecular composition.

The results demonstrate that the combined analytical approach enables effective classification of basil samples by origin and can improve authentication and ensure product integrity within the food supply chain.

Acknowledgments: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS – UEFISCDI, project number PN-IV-P1-PCE-2023-1266, within PNCDI IV.

O-6. Challenges in geographical origin authentication of food ingredients using isotopic fingerprinting: the case of Angus beef meat

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The ever increasing demand in high quality meat products comes with the challenge of authenticating their geographical origin, especially in case of high-end brands of products, in the context of protecting EU producers and consumers. Our desire was to develop a straightforward methodology for authenticating Angus beef and its derivatives. The easiest way to authenticate such products might apparently be to fingerprint, by using the 18O/16O and 2H/1H ratios from extracted water, using cryodistillation. This allows exchange-free isolation of water which can be folowed by analysis using Cavity ring-down spectroscopy. However, this needs to be investigated, as the high turnover rate of water in living animals and different metabolic activity of the tissues involved, might lead to unwanted fractionations or results that might only reflect the recent history of the animal. As such, new methods were devised by using either isotopes of elements with lower turnover rates such as 15N and 13C, and exchange-free separation techniques. This allowed the isolation of more stable molecules with respect to hydrogen, carbon and oxygen isotope exchange, such as fats and proteins, followed by stable isotope analysis by Isotope Ratio Mass Spectrometry. These results represent, from our best knowledge, a first explorative study in the authentication of fresh meat from a limited geographical area.

Acknowledgments

This study was co-financed by the European Regional Development Fund (ERDF) through the Smart Growth, Digitization and Financial Instruments Program (PoCIDIF), call PCIDIF/159/PCIDIF_P1/OP1/RSO1.1/PCIDIF_A1.1, Project SMIS number 329011.

O-7. Random Forest–Driven Feature Selection and Metabolite Panel Identification in Urinary Metabolomics for Breast Cancer Classification

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Untargeted urinary metabolomics, combined with advanced machine learning, offers a powerful route toward non-invasive breast cancer (BC) detection. A central challenge remains the extraction of stable, interpretable biomarker panels from high-dimensional datasets. Here, we present a Random Forest (RF)–based framework using Gini index feature importance for classification and targeted dimensionality reduction across independent metabolomics cohorts.

Two urinary metabolomics datasets ($n = 50$ and $n = 75$), generated using distinct UHPLC–QTOF–ESI$^+$ platforms, yielding 224 and 129 metabolic features, respectively, were analysed using a unified supervised pipeline. The RF models achieved high classification performance (test accuracy up to 94%, ROC-AUC approaching 1), demonstrating strong predictive capability across analytically diverse datasets.

Feature importance ranking enabled the identification of concise panels of 25 metabolites per cohort, preserving classification performance while reducing model complexity. Putative metabolite annotation revealed key discriminative features, including sulfolithocholic acid, testosterone sulfate, ceramide species, palmitoleyl linolenate, 25-hydroxyvitamin D_2, and indole derivatives, highlighting alterations in lipid, steroid, and amino acid metabolism associated with BC.

Several identified metabolites are consistent with biomarkers previously reported using established statistical approaches, demonstrating that the RF-based framework can reproducibly recover biologically relevant features within a controlled and interpretable modelling strategy. Concordance between RF-derived Gini rankings and PLS-DA VIP scores further supports the reliability of the selected features.

This study demonstrates that RF-based feature selection enables compact, biologically meaningful metabolite panels with high predictive accuracy, supporting scalable biomarker discovery and future clinical translation.

O-8. Molecular Dynamic Model Robustness Evaluation For 2D Nanoflakes-Bacterium Interactions In Solution

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Understanding the interaction between nanomaterials and biological membranes is crucial for advancing applications in nanomedicine and antimicrobial therapies. Nanomaterials such as MoS_2 and WS_2 nanoflakes exhibit unique physical properties that could be used for biomedical applications [1].

A numerical model based on Molecular Dynamic (MD) simulation was developed by our research group to study the dynamic of interaction between nanosheets (NSs) and the membrane of the bacterium and to help potential advance in the use of nanomaterials as antimicrobial agents. Because such modelling is new, in this study we shortly introduce how it was constructed to reproduce the average mechanical interaction between NSs and membrane and we principally test the robustness of the MD simulations. Two main tests were performed: the first test is done by parameter swapping of the average repulsion between NSs and of the affinity between membrane and NSs to see if the model is stable, and therefore generalizable, and how the results of the simulations change in function of these variables. Second, we test different model for the NSs geometry to optimize it for simulations, and we try different shape of the potential, tabulated ad hoc to reproduce the DLVO potential. Once the model tested, we show how nanoflake material and concentration significantly influence the interaction with the bacterial surface.

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O-9. Automated Large-Scale Bayesian AUC Estimation Using Web-Based Platforms: A scalable data Analysis pipeline for clinical pharmacokinetics

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In clinical pharmacology, the area under the concentration–time curve (AUC) is more closely associated with drug efficacy and toxicity than single plasma concentrations. However, conventional AUC evaluation requires multiple samples and manual processing, limiting its routine use and large-scale applicability. Bayesian pharmacokinetic methods allow AUC estimation from a single dosage but typically rely on complex models.

We developed an open-source automation tool in R utilising the Chromote package to enable large-scale Bayesian AUC estimation via web-based platforms. The system processes datasets containing laboratory concentration measurements and dosing information, automatically navigates to online Bayesian engines, submits each case and retrieves AUC estimates.

The proposed pipeline successfully processed over 12,000 pharmacokinetic records across three execution runs with an average 0,2% variation between runs. The average computation time was approximately 3 seconds per case. Online platforms demonstrated stable performance under automated large-scale use with best performance in the vancomycin therapetic inteval.

This study demonstrates the feasibility of browser automation as a scalable data analysis layer for biomedical, pharmacokinetic and research applications. The proposed system reduces operator workload, minimises transcription errors, and enables reproducible AUC estimation. Integration with laboratory information systems via file transfer protocols enhance fully automated therapeutic drug monitoring workflows, supporting real-time clinical decision-making in medical laboratories.

O-10. Operational Thermodynamic Criterion for Detecting Non Additive Effects in Complex Aqueous Systems from Experimental Data

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The interpretation of complex aqueous systems in environmental and biomedical analysis is often limited by the assumption of additive behavior, although measurable properties frequently reflect interactions that extend beyond pairwise contributions. This work introduces an operational thermodynamic criterion for detecting non additive effects directly from experimental data.

The approach is based on comparing the real system response with an additive reference defined under identical conditions. The deviation between these two states provides a direct and measurable indicator of cooperative contributions. To quantify this effect, a normalized index derived from residual concentrations is used, enabling consistent comparison across systems of different chemical composition. Unlike empirical descriptors, the proposed formulation is explicitly linked to Gibbs free energy, ensuring a transparent thermodynamic interpretation.

The framework is illustrated using representative multicomponent aqueous systems with coupled equilibria, where non additive effects influence observable parameters such as solubility, chemical speciation, and pH dependent transformations. The analysis shows that these effects can be detected under realistic conditions and can serve as a practical criterion for distinguishing independent from cooperative behavior.

From an analytical perspective, the method extends the informational content of standard measurements without requiring additional instrumentation. This makes it suitable for routine analysis of complex environmental systems and supports improved interpretation of water quality data and chemically heterogeneous matrices. The proposed approach is consistent with recent thermodynamic developments for identifying cooperative effects in heterogeneous systems.

O-11. From HPTLC Bioactivity Profiling to HR-MS/MS Characterization of Lamium album

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Keywords: *Lamium album*, HPTLC–EDA, HR-MS/MS, Tentative compound identification, Enzyme inhibition

Lamium album ("white dead nettle") is a medicinal plant of considerable pharmacological interest [1], but its bioactive profile remains insufficiently characterized. This study evaluated the bioactivity of ethanolic extracts obtained from the aerial parts and flowers, while selected chromatographic zones were subjected to tentative compound identification by HR-MS/MS.

HPTLC on silica gel 60 F_{254} plates using n-hexane – ethyl acetate – methanol (5:4:1, *V/V/V*) as mobile phase enabled good separation across the full hR_F range, allowing the distribution of both polar phenolic constituents and less polar lipid-derived metabolites. Derivatization with NP/PEG, $AlCl_3$ and anisaldehyde supported preliminary phytochemical classification. The developed plates were further subjected to antioxidant, enzyme inhibition (α-amylase, α-glucosidase, lipase and acetylcholinesterase) and antibacterial assays against *Bacillus subtilis*, revealing multiple active zones, generally stronger in the aerial parts, while some characteristic bands were common to both plant parts.

HR-MS/MS analysis enabled the tentative characterization of fatty acid-derived metabolites, flavonoid-related compounds and phenolic amides, including tricoumaroyl spermidine, reported for the first time in *L. album* [2]. The combination of HPTLC fingerprints, on-plate assays and HR-MS/MS allowed the direct correlation of chromatographic bands with their biological effects and the tentative assignment of the compounds responsible for the observed activities. These findings confirm HPTLC–EDA combined with HR-MS/MS as an effective strategy for rapid screening and tentative characterization of bioactive plant metabolites.

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[2] J. Baumli, Á.M. Móricz, C. Cimpoiu, *J. Chromatogr. B,* 2026 , *1275*, 3233.

O-12. Jones Matrix Reconstruction of Polarization Diffraction Gratings

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We report on the quantitative characterization of polarization diffraction gratings using Jones matrix reconstruction. The gratings are fabricated by a one-beam direct polarization recording method using a continuous-wave on As_2S_3–Se nanomultilayer structures. A half-wave plate and a liquid crystal polymer depolarizer (LCPD) are used to control and spatially modulate the polarization state of the beam. By adjusting the orientation and axial position of the LCPD, a periodic polarization pattern is generated, enabling the inscription of diffraction gratings with a spatial period of approximately 15 µm. The beam is spatially filtered and shaped using an iris and a 4-f system.

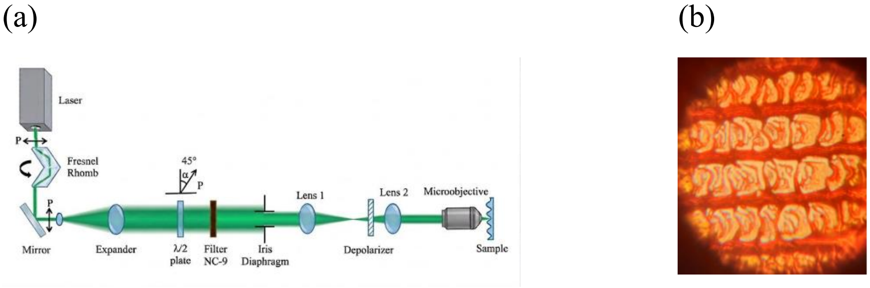

Figure 1. (a) One-beam direct polarization grating Recording CW DPSS laser (λ = 532 nm, P = 100 mW, power density on the sample ≈ 6.4 mW/mm²), Expander, Grating -recorded on NML; λ/2- half wave plate; (b) The obtained polarization diffraction grating, with resolution 0.41 µm.

The fabricated gratings are analyzed Jones matrix calculations obtained from polarization-sensitive digital holograms. The results show a periodic phase difference between orthogonal polarization components, indicating strong induced birefringence in the nanomultilayer.

Acknowledgments (if applicable)

The National Agency for Research and Development of Moldova (NARD) project under project number 25.80012.5007.39TC and 25.80013.8007.01ROMD

O-13. Nanoengineered Biomaterials for Enhanced Diabetes Monitoring

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The growing demand for efficient and portable diabetes monitoring technologies has intensified the search for advanced nanoengineered biomaterials and biosensing architectures. Hybrid nanomaterials can enhance electrochemical performance and support the development of robust, miniaturized biosensors. The incorporation of conductive nanostructures improves charge transfer efficiency and signal amplification, which are critical for accurate metabolic analyte detection in portable applications.

Bioinspired coatings, including polydopamine and polynorepinephrine, optimize interfacial properties and ensure stable enzyme immobilization within the sensing layer. Their primary role is to improve biocompatibility and structural stability while providing additional functional groups that facilitate enzyme attachment. The resulting enhancement in enzyme loading is considered an auxiliary benefit rather than the principal design objective.

These hybrid biomaterial systems demonstrate strong potential for integration into wearable and portable diabetes monitoring devices, offering reliable analytical performance, scalability, and adaptability. The described concept contributes to the advancement of innovative biosensing platforms for decentralized diabetic diagnostics and personalized healthcare. Furthermore, such monitoring technologies support the development of telemedicine by enabling remote patient supervision and significantly improving the accessibility of medical measurements.

Funding

This work was financed by the Poznan University of Technology research grant no. 0912/SBAD/2611.

O-14. Microfabricated Si/SiO₂ Electrodes Functionalized with Molecularly Imprinted Polymers for Detection of Environmental Contaminants

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The development of miniaturized, highly sensitive electrochemical sensors for environmental monitoring requires the integration of advanced functional materials with scalable microfabrication technologies. In this work, we report the design and fabrication of Si/SiO_2-based electrochemical platforms incorporating nanocrystalline graphite (NCG) as a silicon-compatible working electrode material. NCG films were directly grown on thermally oxidized silicon substrates via plasma-enhanced chemical vapor deposition (PECVD), enabling wafer-level integration, excellent electrical conductivity, and stable electrochemical performance comparable to conventional glassy carbon electrodes.

The microfabricated chips were configured in a three-electrode architecture and further functionalized with molecularly imprinted polymers (MIPs) to achieve selective detection of environmentally relevant contaminants. Two distinct MIP systems were developed: a chitosan-based MIP for glyphosate (GLY) recognition and a polypyrrole (PPy)-based MIP for bisphenol A (BPA). The MIP layers were synthesized directly on the NCG surface via electrochemical deposition in the presence of the target analytes, followed by template extraction to generate selective binding cavities.

Electrochemical characterization using cyclic voltammetry and electrochemical impedance spectroscopy in ferri/ferrocyanide redox probes confirmed successful surface modification and enhanced interfacial properties. The resulting MIP-functionalized sensors demonstrated sensitive and selective detection of GLY and BPA through indirect signal transduction mechanisms, based on changes in charge transfer resistance and peak current.

This approach highlights the synergistic combination of silicon microfabrication, carbon-based nanoarchitectures, and molecular imprinting strategies, offering a robust pathway toward portable, low-cost, and high-performance sensing devices for environmental monitoring applications.

FUNDING This work was supported by a Romanian grant of the Ministry of Education and Scientific Research through CCCDI UEFISCDI, project number PN-IV-P7-7.1-PED-2024-0558, within PNCDI IV.

O-15. Microplastics in Aquatic Ecosystems: Assessment and Remediation by Advanced Oxidation Processes

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In recent years, plastic material consumption has increased exponentially due to its ease of processing and its remarkable properties. Plastics released into aquatic environments can fragment into smaller particles through chemical, biological, and physical processes, resulting in significant amounts of microplastics (MPS). Although the presence and distribution of MPs have been extensively studied in aquatic environments, limited research is currently available on the Danube River-Danube Delta-Black Sea system. In this context, the present study aims to assess the abundance, distribution, and physicochemical (polymer type, size and colour) characteristics of MPs in the Danube Delta, via Sf. Gheorghe distributary. Analysis of sediment and water samples combining vibrational spectroscopy, optical and electron microscopy, confirmed the presence of MPs in all analysed samples, including those from isolated areas with minimal anthropogenic activity. Most microplastics (MPs) were small particles (≤ 1 mm), predominantly colored. Fibers were the most common shape, followed by fragments. After μ-FTIR spectroscopy analysis, the samples showed greater polymer diversity, including PTFE, PP, PS and PE fragments and PES/PET, PA, and FC synthetic fibers, suggesting multiple sources and pollution pathways within the Danube ecosystems. Considering their harmful effects, it is essential to develop effective approaches to convert them into less toxic by-products. In this context, piezo-photocatalysis employing nanostructured ZnO-Au catalyst under simulated solar light irradiation and mechanical vibrations was explored to achieve enhanced degradation of LDPE MPs.

Acknowledgment: This research was supported by the Ministry of Research, Innovation, and Digitization, CNCS-UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0258, within PNCI IV program.

O-16. Electrochemical and AFM Characterisation of POT1 Binding Mechanisms with Human Telomeric DNA

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Protection of Telomeres 1 (POT1), a key single-stranded DNA-binding component of the shelterin complex, regulates telomere length and structural integrity by selectively recognising 5′-TTAGGG repeats and modulating G-quadruplex (GQ) folding equilibria. Despite its biological relevance, the interfacial behaviour of POT1 and its mechanistic interaction with telomeric DNA remain insufficiently understood at the molecular level. Herein, we combine atomic force microscopy (AFM) and differential pulse voltammetry (DPV) to investigate the adsorption, redox activity, and binding dynamics of POT1 with the human telomeric sequence d(T2AG3)4 under electrochemically controlled conditions.

AFM imaging of POT1 adsorbed onto highly oriented pyrolytic graphite reveals concentration-dependent self-assembly into heterogeneous nanometric aggregates, preferentially nucleated at step edges and defect sites, reflecting the influence of protein hydrophobic domains and conformational heterogeneity. Electrochemical characterisation at glassy carbon electrodes identifies two oxidation processes, attributed to electron transfer from electroactive residues. Interaction studies were performed under two conditions: POT1 binding to single-stranded DNA and to pre-formed GQs in K^+ media. In the presence of single-stranded d(T2AG3)4, a strong decrease in POT1 and guanine oxidation signals was observed, indicating binding that suppresses electron transfer and inhibits GQ formation. Conversely, pre-formed GQs showed minimal interaction with POT1 and preserved GQ electrochemical signatures. These results demonstrate that POT1 selectively stabilises single-stranded telomeric DNA while exhibiting limited affinity for folded GQs. The combined AFM–electrochemical approach provides mechanistic insight into protein–DNA interactions at interfaces, relevant for telomere biology and biosensing applications.

Acknowledgments: Fundação para a Ciência e a Tecnologia (FCT) - Portugal, project 2023.12922.PEX, CEMMPRE, project UID/00285/2025, ARISE, project LA/P/0112/2020, by FEDER funds through the program COMPETE – Programa Operacional Factores de Competitividade, and by national funds through FCT.

O-17. Synthesis of Amphiphilic Multi-responsive Terpolymers: Nanoformulation Studies with Anticancer and Aggregation-Induced Emission Molecules

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Multi-responsive polymers are at the forefront of research due to the tunability in their physicochemical properties under different external stimuli. Structural conformational changes enable them to be promising candidates for biomedical and environmental applications. In this research, a series of multi-responsive amphiphilic statistical copolymers was designed and synthesized via a one-pot RAFT polymerization scheme. Poly(2-(diisopropylamino)ethyl methacrylate-co-2-(dimethylamino)ethyl methacrylate-co-oligoethylene glycol methyl ether methacrylate), P(DIPAEMA-co-DMAEMA-co-OEGMA) terpolymers demonstrate low dispersity indexes, while the self-assembly of the polymeric chains in different aqueous media revealed the pH-responsiveness of the micelles. Further DLS studies under different temperatures showed the temperature-dependent behavior of the nanosystems. The natural anticancer molecules curcumin and quercetin were loaded in the micelles via the co-solvent protocol. Nanocarriers remained stable for three weeks, presenting low protein corona formation after the addition of FBS/PBS medium. Furthermore, the aggregation-induced emission phenomenon was observed, as curcumin and quercetin present AIE properties apart from their anticancer activity. Smart nanocarriers were formulated enabling the utilization of these nanosystems in image-guided drug delivery or surgery.

O-18. Semiconducting Nanotubes and Nanoparticles-Polymer Composites with Photocatalytic Properties

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The rapid growth of the global population has increased the need for efficient fabrication methods and for materials used for polluted water's treatment. The presentation summarizes the studies regarding the fabrication methods and photocatalytic properties of materials with potential use in wastewater treatment, semiconducting nanotubes (ZnO and TiO2) [1] and PDMS sponge-like composites incorporating semiconducting nanoparticles (TiO2) [2]. Semiconducting nanotubes for photocatalytic applications were obtained by a three-step fabrication process starting from polymer fibers produced by electrospinning. The ZnO and TiO2 nanotubes assembled in web-like architectures (single crystalline phase) present interesting photocatalytic properties demonstrated by Rhodamine B (RhB) degradation under irradiation with white light of a solar simulator. The interesting capabilities of the ZnO and TiO2 nanotubes are given by the fact that the photocatalytic process takes place up to the total bleaching of contaminants in solutions, even for a small number of nanotubes, and by the possibility of removal of web-like constructed nanotubes after the degradation process. Reusable and efficient three-dimensional polydimethylsiloxane (PDMS) sponge composites designed for water treatment applications were prepared by sacrificial templates' fabrication method, tailoring the sponge's morphology and the interconnected pores' distribution. To achieve an enhanced photocatalytic activity, semiconducting nanoparticles were incorporated (TiO2) at different concentrations into the PDMS matrix. The efficiency of 3D TiO2@PDMS composites was demonstrated by complete degradation of RhB even at small concentration of TiO2 and the reusability of the sponges was evaluated through multiple consecutive degradation cycles.

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O-19. Design of Innovative Bacterial Cellulose Based Gels for Wound Dressings Applications

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In medical patches, the long-term performance of conventional hydrogels is limited by thermodynamic instability, as water evaporation under ambient conditions induces dehydration, structural collapse, and loss of mechanical integrity, often leading to brittle, adherent dressings that may cause secondary trauma upon removal [1].

Bacterial cellulose (BC), a naturally derived polysaccharide biosynthesized by Komagataeibacter xylinus, is a versatile biomaterial with applications spanning food technology, cosmetics, flexible electronics, sustainable packaging, and wound dressings due to its high-water content (98% wt.), mechanical properties, biocompatibility and biodegradability [2].

In this study, BC was modified to enhance moisture retention and antimicrobial performance for wound dressing applications. Specifically, BC was combined with sodium alginate and ionically cross-linked using varying concentrations of cross-linking agents to improve hydration stability. Additionally, a novel approach integrating hydrophilic BC and alginate with hydrophobic sea buckthorn supercritical extract into a unified gel matrix was developed [3].

The resulting materials were characterized by scanning electron microscopy (SEM), mechanical compression tests and evaluated for antimicrobial activity against Escherichia coli, Bacillus subtilis, and Candida albicans. Furthermore, positron annihilation lifetime spectroscopy (PALS) was employed to investigate free volume characteristics at the nanoscale, providing insight into porosity and the effects of cross-linking on the BC-based materials.

These findings highlight the potential of modified BC as a tunable platform for advanced wound dressings with improved mechanical stability, moisture management, and antimicrobial functionality.

A.Mocanu acknowledges for financial support from the Ministry of Education and Scientific Research, CCCDI - UEFISCDI, project number: PN-IV-P7-7.1-PTE-2024-0305, contract no. 40PTE/2025 and Core project number PN 2307 8N/03.01.2023, μNanoEl, within PNCDI IV (2022-2027).

O-20. Plasmonic Colorimetric Detection of Volatile Analytes Using Core-shell Gold-silver Nanoparticles on Cellulose Substrates and Liquid Films

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Plasmonic colorimetric nanosensors have emerged as a promising strategy for the sensitive detection of volatile analytes, particularly when implemented in integrated enrichment/sensing approaches. In this contribution, two liquid-phase microvolume configurations combined with colorimetric detection are explored for volatile enrichment, namely quasi-spherical drops and planar liquid films. First, widely available waterproof cellulose materials (Whatman 1PS, polyethylene-coated filter and tracing paper) were evaluated as holders for microvolume drops. These substrates enable the direct exposure of volatiles to the sensing plasmonic materials, while also serving as integrated compartments for smartphone-based colorimetric detection. Among these materials, Whatman 1PS was compatible with a range of colloidal solutions and allowed the use of relatively large drop volumes (≥20 µL) for enrichment/sensing purposes. The responsiveness of core-shell Au@AgNPs toward H2S was exploited for the development of a colorimetric smartphone-based assay for the determination of acid-labile sulfide in environmental waters, using Whatman 1PS, yielding a detection limit of 0.46 µM, along with satisfactory precision and quantitative recoveries [1]. The second approach relied on the use of stainless-steel safety pins for the affordable and reproducible formation of planar liquid films of plasmonic NPs, used as acceptor phases with enhanced surface area-to-volume ratios in enrichment studies. Liquid films of AuNPs containing Tollens´ reagent allowed formaldehyde enrichment/sensing via in situ formation of core-shell Au@AgNPs, achieving 2.2-3.0-fold higher enrichment factors compared to alternative liquid-phase microextraction approaches. This method yielded a detection limit of 56.7 nM, being applied to water and textile samples [2].

Acknowledgments

The authors thank the MCIN/AEI/10.13039/501100011033/FEDER, UE (Projects RTI2018-093697-B-I00 and PID2022-136337OB-I00).

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O-21. Miniaturized Fluorometric Determination of Nitrite in Water Using Hydrophobic Paper-Based Analytical Devices

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The growing demand for greener, low-cost, and miniaturized analytical methodologies has positioned paper-based analytical devices (PADs) as versatile platforms for chemical sensing.1 Hydrophobic cellulose substrates allow microdroplet confinement on their non-wetting surface, enhancing signal intensity and enabling direct localized measurements. The reaction between nitrite and 2,3-diaminonaphthalene (DAN) is a well-established fluorometric strategy that forms the highly emissive and stable product 1-[H]-naphthotriazole under acidic–basic conditions.2 In this work, an innovative and sustainable miniaturized method for nitrite determination in water samples is presented, integrating the DAN fluorometric reaction within a confined microdroplet supported on hydrophobic PAD. The substrate simultaneously serves as the reaction medium and detection platform, enabling rapid (10 min) and low-reagent assays. Under optimized conditions, the method demonstrated strong tolerance to common ions and excellent analytical performance, achieving a limit of detection of 0.3 μg/L with good precision (RSD ≤ 3.5%). Accuracy was confirmed through recovery studies with values ranging from 83–115%. The method was applied to water samples analysis showing nitrite levels below regulatory limits. The approach aligns with green analytical principles, requiring only 5 μL of reagents and generating no liquid waste.3 This study introduces a novel combination of hydrophobic cellulose substrates with DAN-based fluorometric nitrite sensing, achieving lower quantification limits than conventional reference methods while providing a simple, fast, and environmentally friendly alternative for nitrite monitoring.

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Authors thank MCIN/AEI/10.13039/501100011033/FEDER, UE (PID2022-136337OB-I00) project, AQUASENSE funded by Deput. Pontevedra-2025 and the CAPES, Brazil – Finance Code 001, for financial support.

Poster Communications

P-1.Comparison of scalar and vector features for segmentation of stained and unstained cells from cavity serous fluids

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Analysis of cells from serous cavities plays a critical role in diagnosis and prognosis of advanced malignancies. Conventional cytological evaluation based on brightfield microscopy of stained samples remains challenging due to morphological similarities between benign and malignant cells. Hyperspectral microscopy, as an alternative, provides hyperspectral images (HYSIs), containing in each pixel spectral profiles (HSP), vectors with 468 elements (in 400–1000nm spectral range with 1.28nm spectral resolution), capturing detailed biochemical and structural information about stained and unstained cells.

In this study, HYSs of cells collected from a patient with ovarian cancer were acquired. A feature extraction strategy was developed for pixels classification in nucleus, cytoplasm and background classes. Performances of segmentation based on scalar (SFs) or vector (VFs) handcrafted features were compared. HSPs, their first, second, and logarithm derivatives were considered VFs. SFs were computed from VFs by treating each HSP as continuous function and discrete vector. An automated machine learning pipeline was implemented using scikit-learn enabled model selection, hyperparameters optimization, and ensemble learning.

Optimized spectral feature selection improved classification performance, achieving high accuracy for both stained/unstained samples. These findings highlight the potential of hyperspectral microscopy with machine learning for rapid, non-invasive, and reproducible cytology, supporting improved diagnostic workflows in clinical practice.

Acknowledgements: This work was supported by research project 8PED/2025, PN-IV-P7-7_1-PED-2024-1895. Hyperspectral system were acquired due to European Regional Development Fund through Competitiveness Operational Program 2014-2020, Priority axis 1, INOVABIOMED

P-2. Nutritional quality of fresh cow cheese based on GC-FID analysis: fatty acid composition and cardiovascular indices

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This study involved a nutritional quality assessment of Romanian fresh cow cheese (*brânză de vaci*), based on the quantification of 37 individual fatty acids (FA) and 18 nutritional indices by gas chromatography with flame ionization detection (GC-FID). Lipid composition was dominated by saturated fatty acids (SFA = 57.1%), with palmitic acid (C16:0 = 34.9%) as the principal component. The monounsaturated fatty acid (MUFA) fraction accounted for 37.7% of FA, mostly due to oleic acid (C18:1n9 = 20.6%) and myristoleic acid (C14:1 = 14.1%). Polyunsaturated fatty acids (PUFA) represented 5.2%, including linoleic acid (LA, C18:2n-6 = 3.1%) and α-linolenic acid (ALA, C18:3n-3 = 0.4%).

Atherogenicity Index (0.86) was below the critical threshold of 1.0, suggesting no significant atherogenic risk with moderate consumption. Thrombogenicity Index (TI = 1.66) exceeded the reference value of 1.5, expected considering the diary-specific SFA composition. The h/H ratio (0.69) was below the optimal threshold of 1.0, highlighting the predominance of hypercholesterolemic SFA over hypocholesterolemic MUFA&PUFA, which is a characteristic feature of milk fat.

The n-6/n-3 PUFA ratio (6.48) was within the WHO range (< 10:1), and the LA/ALA ratio (8.48) conformed to EFSA guidelines (< 10:1). The Nutritive Index (NI = 3.51) was favorable (> 1.0), along with a high Desaturation Index (DI 18 = 0.76), indicating a positive contribution of PUFA to overall lipid quality.

These results provided a comprehensive nutritional characterization of lipids in *brânză de vaci*, supporting its moderate inclusion in balanced diets, with significant quantities of beneficial PUFA and MUFA.

This paper was co-financed by the European Regional Development Fund (ERDF) through the Smart Growth, Digitization and Financial Instruments Program (PoCIDIF), call PCIDIF/159/PCIDIF_P1/OP1/RSO1.1/PCIDIF_A1.1, Project SMIS number 329011.

P-3. Vibrational Spectroscopy as a Rapid Tool for Spice Authentication

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Spice authentication has become increasingly important due to the growing incidence of food fraud and economic adulteration within the global food supply chain. Ground spices are particularly vulnerable to adulteration through the addition of low-cost matrices or by-products, which may alter both their nutritional quality and sensory properties. In this context, rapid, non-destructive, and cost-effective analytical techniques are highly important for routine monitoring and authenticity assessment.

The present study investigates the applicability of vibrational spectroscopies (FT-IR, FT-Raman) for the rapid authentication of black pepper, garlic powder, and sweet paprika. The vibrational profiles of authentic spice samples were analysed to identify characteristic spectral fingerprints and differentiation markers specific to each spice matrix. Major absorption bands were assigned to the predominant compounds naturally present in the spices. In this context, black pepper samples showed prominent bands associated with piperine and aromatic structures, garlic powder presented characteristic carbohydrate and organosulfur-related vibrations, while paprika spectra were dominated by signals attributed to carotenoids and polysaccharide structures. The acquired spectral data were subjected to advanced multivariate statistical analysis to reveal the characteristic spectral markers responsible for the differentiation of each spice category.

The results demonstrate that vibrational spectroscopy provides valuable molecular-level information and can represent a rapid and efficient tool for spice authentication and quality evaluation. The proposed approach highlights the potential of vibrational spectroscopy to detect compositional differences.

Acknowledgments: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS – UEFISCDI, project number PN-IV-P1-PCE-2023-1266, within PNCDI IV.

P-4. Beef tripe as an unusual source of healthy fatty acids

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Beef tripe, a once common food ingredient, has mostly become a niche product in many parts of the world, altough it is still popular in many parts of the eastern Europe.

Because the nutritional value of tripe is often ignored, we assessed the fatty acid profile of Angus beef trype, a superior grade of beef, through GC-FID analysis. The results yelded some important conclusions, such as the monounsaturated fatty acid (MUFA) profile similar to the one of olive oils, and a high total unsaturated fatty acid content. Risk indices were calculated based upon these values, and these have shown a good Atherogenic Index (0,444) low risk of thrombogenicity (thrombogenicity index of 0.933) and a healthy ratio of hypochlolererolemiant vs. hypercholesterolemiant fats (1,895) due to the superior content of unsaturated fatty acids (64,8% of total fatty acids).

Altough the fat content is predominantly consisting of “good fats”, the fact that 35,2% of the total fatty acids are saturated leads to a recommendation of moderate consuption, in order to avoid other health risks.

Acknowledgments

This study was co-financed by the European Regional Development Fund (ERDF) through the Smart Growth, Digitization and Financial Instruments Program (PoCIDIF), call PCIDIF/159/PCIDIF_P1/OP1/RSO1.1/PCIDIF_A1.1, Project SMIS number 329011.

P-5. Exploration of novel antifungal agents capable of forming synergistic interactions with polyene and azole antibiotics

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Compounds from the 1,3,4-thiadiazole group constitute a promising class of heterocycles with a broad spectrum of biological activity, including antifungal activity. Due to increasing microbial resistance, there is growing interest in new substances and their potential synergistic effects with drugs, which may increase therapy efficacy and allow for dose reduction.

The aim of this study was to evaluate the antifungal activity of a selected 1,3,4-thiadiazole derivative compared to amphotericin B, flucytosine, and natamycin. MIC and FICI values were determined, and cytotoxicity studies were conducted. The compound demonstrated low toxicity (MIC/CC50 > 2) and a synergistic effect with amphotericin B against Candida albicans and Candida parapsilosis, as well as with natamycin against C. parapsilosis. Additive or neutral effects were observed for flucytosine.

Analysis of the mechanism of action using spectroscopic methods (UV-Vis, fluorescence – including synchronous spectra, RLS, and fluorescence lifetimes) confirmed interactions between the tested compound and the drugs. The results indicate that 1,3,4-thiadiazole derivatives, including TD-MP-DEA, may be promising components of combination therapy, requiring further mechanistic studies.

P-6. Aptamer-Functionalized Au Nanotrenches Arrays for the Ultrasensitive Detection of Acetylcholine

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Neurodegenerative disorders are associated with complex biochemical dysregulation, where reliable detection of clinically relevant biomarkers remains a significant challenge. In this work, we report the fabrication of an ultrasensitive, aptamer-based sensor which incorporates gold (Au) nanotrenches fabricated using nanoimprint lithography (NIL) and magnetron sputtering (MS) deposition method for acetylcholine (ACh) detection at pM concentration. A thiolated aptamer with high specificity toward ACh was immobilized onto periodical nanotrenches covered with Au thin films. Initial binding conditions optimization was performed on colloidal Au nanoparticles *via* UV-Vis spectroscopy. Planar Au surfaces were employed to determine the optimal aptamer surface density and confirm aptamer binding and ACh recognition as low as 10^{-13} M, using surface plasmon resonance (SPR) spectroscopy. Subsequently, the optimized functionalization conditions were translated to the nanotrenches-based Au electrodes, ensuring comparable surface coverage. Electrochemical characterization was carried out to evaluate the sensing performance of the system. Analytical performance parameters, including sensitivity, limit of detection (LoD), and limit of quantification (LoQ), were determined based on differential pulse voltammetry (DPV) demonstrating effective molecular recognition at ultra-low levels. The integration of plasmonic and electrochemical approaches highlights the potential of aptamer-functionalized Au nanostructures for the development of highly sensitive biosensing systems targeting disease biomarkers.

Acknowledgements: This work was supported through the "Nucleu" Program within the National Research Development and Innovation Plan 2022–2027, Romania, carried out with the support of MEC, project no. 27N/03.01.2023, component project code PN 23 24 01 02.

P-7. Insight into the photo(piezo)-assisted adsorption and catalytic activity of nanostructured ZnO coatings and FHY nanoparticles for the degradation of Reactive Red 120 dye

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Annually, various dyes used in the paint, textile, paper, food, plastic, pharmaceutical, and biological industries reach water bodies, adversely affecting aquatic ecosystems and human health. These compounds are non-biodegradable or only slowly degradable under natural conditions. Consequently, considerable attention has been devoted to the development of chemical and physical processes for dyes removal/ degradation from wastewater. Each approach has its own advantages and limitations, and there remains a need to explore alternative and complementary strategies for the effective dyes removal, particularly those with large molecular structures, such as Reactive Red 120 (RR120). In this context, the amorphous ferrihydrite nanoparticles (FHY NPs) and nanostructured zinc oxide (ZnO) films were utilized as adsorbents and catalysts for the removal/degradation of RR120 in aqueous media. FHY NPs were synthesized by hydrolysis, whereas ZnO films were deposited using a novel synthesis approach: pulsed thermionic vacuum arc (p-TVA) technique, followed by annealing in an oxygen atmosphere. The RR120 removal via adsorption and catalytic processes under simulated sunlight and mechanical vibrations was investigated to identify the optimal treatment process. Kinetic analysis showed that approximatively 100% uptake and/or degradation of RR120 via piezo-assisted adsorption onto FHY NPs was faster (15 min) than that achieved by piezo-assisted photocatalysis using ZnO film (240 min). However, ZnO coating displayed very good reusability with maximal efficiency over four consecutive cycles. Furthermore, scavenger experiments identified the main active species involved in the adsorption and catalytic reactions. Overall, the results support the selection of suitable materials and hybrid processes for refractor azo dye removal.

P-8. Peptide Substrates-Based Approaches for Enzymatic Diagnosis of Rare Diseases

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Lysosomal storage diseases (LSDs) are a group of rare, inherited metabolic disorders caused by impaired lysosomal function, leading to the accumulation of undegraded macromolecules and progressive multisystemic damage. Early diagnosis is essential, as several LSDs benefit from enzyme replacement therapy or other targeted interventions that are most effective when initiated promptly. Traditional diagnostic methods, mainly fluorometric assays and selective mass spectrometry applications, often face limitations in sensitivity, specificity, and multiplexing capacity.

Peptide substrates based approaches offer a modern and highly effective alternative for improving diagnostic accuracy. Newly developed synthetic substrates, including alkyl umbelliferon–derived peptide structures, enable simultaneous fluorometric and mass spectrometric assessment of multiple lysosomal enzymes from a single dried blood spot (DBS). Their optimized chemical design enhances enzymatic specificity, improves MS ionization efficiency, and reduces analytical background. Integrated into multiplex MS MRM workflows, these substrates allow parallel quantification of several enzyme activities, significantly increasing diagnostic throughput and improving differentiation between affected patients, carriers, and healthy individuals.

By combining innovative substrate chemistry with advanced analytical platforms, peptide substrates based methodologies provide a rapid, sensitive, and scalable diagnostic solution with strong potential for early detection, large scale screening, and improved patient outcomes.

Acknowledgments

The present study was financially supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI–UEFISCDI, project number PN-IV-P1-PCE-2023-0678.

P-9. Mixture viscosity and effective hardness of lignocaine-embedded maltose-based dissolvable microneedles

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This paper analyses viscosity and hardness of lignocaine-embedded maltose-based dissolvable microneedles. Dissolvable microneedles (DMNs) are innovative method to transdermally deliver drug into patient's skin without causing pain. Thus, the microneedles' mixture viscosity and its resulting effective hardness play an important role in determining their skin puncturing ability and efficacy in transdermal drug delivery. The microneedles were fabricated using moulding technique before being densified and cured. Viscosity measurements was carried out to identify the suitable formulation for comprehensive mould filling and reproducible microneedles formation. Water volume of 7.5, 8.0, 8.5, 9.0 and 9.5 mL were tested. Texture analysis was performed to determine the hardness of the fabricated microneedles. The hardness values were determined by taking the highest peak on the load-displacement hysteresis curve and converting the values into hardness by dividing the load values with the effective surface areas at the tip of the microneedles. It was observed that formulation with 8.0 mL (51.4 wt%) water has the highest hardness value of 30 MPa and has excellent morphology when observed under FESEM. This hardness value is sufficient to penetrate the stratum corneum and epidermis layer of the skin, which require a penetration pressure of approximately 3.18 MPa to overcome the elasticity and resistive force of the outermost skin layer. This value is also well above the 10-20 MPa hardness value range required for microneedles to safely penetrate skin without bending, snapping of fracturing to ensure successful transdermal drug delivery.

P-10. DES-Electropolymerised MWCNT Sensor for Dual Salicylic Acid and Acetaminophen Detection

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A novel electrochemical sensor based on multiwalled carbon nanotube (MWCNT)-modified glassy carbon electrodes (GCE) and electropolymerised functional films has been developed for the simultaneous detection of salicylic acid (SA) and acetaminophen (APAP). Two redox polymers, poly(bromocresol purple) (PBCP) and poly(brilliant blue) (PBB), were electropolymerised onto MWCNT/GCE surfaces, using the green deep eutectic solvent (DES) ethaline as the polymerisation medium. Enhanced electron transfer kinetics at the modified electrodes, PBB/MWCNT/GCE and PBCP/MWCNT/GCE, were confirmed by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS), while scanning electron microscopy (SEM) revealed an increased electroactive surface area and uniform film formation. The combination of MWCNTs with electropolymerised films provided a synergistic effect, attributed to improved conductivity, high surface area, and favourable π–π interactions between the analytes and the polymer matrix. Differential pulse voltammetry (DPV) was employed to evaluate the analytical performance of the sensors, enabling the well-resolved and simultaneous oxidation of SA and APAP in aqueous buffer solutions. The modified electrodes exhibited high sensitivity, good selectivity, and excellent reproducibility, with effective discrimination between the two analytes even in mixed systems. The constructed sensors demonstrated good repeatability, reproducibility, and stability. These results show that the electropolymerisation of functional dyes in ethaline onto MWCNT-modified electrodes is a simple, sustainable, and efficient strategy for the development of multi-analyte electrochemical sensors.

Acknowledgments: Fundação para a Ciência e a Tecnologia (FCT) - Portugal, projects 2022.06451.PTDC and 2023.12922.PEX, CEMMPRE, project UID/00285/2025, ARISE, project LA/P/0112/2020, by FEDER funds through the program COMPETE – Programa Operacional Factores de Competitividade, and by national funds through FCT.

P-11. Assembly Mechanisms of Virus-Like Particles Incorporating Gold Nanoparticles

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Virus-like particles (VLPs) are widely used in drug delivery and vaccine development. Assembling VLPs in vitro is used for studying the thermodynamics and kinetics of the assembling processes. Brome mosaic virus (BMV) is one of the simplest and most thoroughly studied plant viruses. The capsid of BMV is composed of 180 identical protein molecules which are clustered into hexamers and pentamers on the surface. The capsid's diameter is about 28 nm and has an 18 nm inner cavity. These capsids can be used for specific and localized treatment; therefore, it is important to study the thermodynamics of their assembling processes. Thus, gold nanoparticles (GNP) with diameters that can be controlled from the synthesis were used as a cargo model.

For incorporation of gold nanoparticles into the viral capsid, the GNP were functionalized with specific ligands which contain hydrophobic alkaline chain with thiol group on one side and polyethylene glycol chain with carboxylic group on other, ensuring the requirements for an assembly promoter: a negative surface charge for interaction with viral proteins, flexibility and hydrophilicity. The size of the gold particle has an influence on the structure of the resulting VLP and altered the yield of VLPs emission and this study propose the investigation of the GNP size influence on the icosahedral configurations of the VLPs and on the assembly mechanisms. For that, GNP with different diameters values were used in fluorescence titration experiments to determine each phase in the assembly process.

Acknowledgments
The authors thank for the financial support of the National Authority for Scientific Research through project PNRR Ctr. 760099/23.05.2023.

P-12. Spectroscopic studies of molecular aggregation in the ESIPT process on the example of a selected 1,3,4-thiadiazole derivative in a micellar system

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The study involved the spectroscopic analysis of 1,3,4-thiadiazole (NTBD) in a micellar environment created by the nonionic surfactant Triton X-100. The primary goal was to investigate the effect of aggregation-induced emission (AIE) on the intramolecular proton transfer (ESIPT) process and the associated dual fluorescence phenomenon. A variety of spectroscopic techniques were employed, including UV–Vis absorption, steady-state fluorescence, fluorescence lifetime measurements (TCSPC), resonance light scattering (RLS), and dynamic light scattering (DLS). SPR and EIS were also used to analyze the interactions between NTBD and micelles.

The obtained results revealed significant changes in the photophysical properties of NTBD in the micellar environment. In aqueous solutions containing Triton X-100, distinct dual-band emission was observed, attributed to the excited enol* and ketone* forms, indicating effective activation of the ESIPT mechanism under conditions favoring aggregation. Increased environmental hydrophobicity and micelle formation favored the formation of dimers and larger aggregates of NTBD, as confirmed by absorption and RLS spectral analyses.

The obtained data indicate that NTBD is a compound highly sensitive to changes in environmental polarity, and the ESIPT process is significantly modulated by the AIE effect. These properties make it a promising candidate as a fluorescent probe for monitoring changes in hydrophobicity in biological and pharmaceutical systems.

P-13. A Calorimetric Study of Two Structurally Amino Compounds

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A comparative calorimetric study of two structurally distinct L-configured amino compounds, namely, L-leucine and L-theanine, was conducted using differential scanning calorimetry and complementary combustion calorimetry techniques. Despite sharing identical stereochemical configuration, the two compounds exhibit significant differences in molecular structure, particularly with respect to side chain polarity and functional group composition, which are expected to influence their thermodynamic behaviour.

DSC analysis was employed to characterize the thermal behaviour, including phase transitions and melting processes, while combustion calorimetry measurements enabled the determination of the associated enthalpies of combustion.

The obtained results demonstrate distinct thermal responses, indicating differences in intermolecular interactions and crystal lattice organization. L-leucine demonstrated a highly ordered crystalline structure stabilized by hydrophobic interactions while L-theanine exhibited an increased conformational flexibility and the presence of polar functional groups capable of forming diverse hydrogen-bonding networks.

The present study highlights the applicability of calorimetric techniques for the systematic investigation of amino compounds and provides relevant insights for their utilization in pharmaceutical and biomolecular contexts.

Acknowledgments

This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS-UEFISCDI, contract number 93TE/03.01.2025, project code PN-IV-P2-2.1-TE-2023-0189, within PNCDI IV.

P-14. Mechanistic Insights into Lysozyme Fibrillation Modulated by Gallic Acid

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Amyloid fibril formation is a hallmark of protein misfolding processes associated with neurodegenerative disorders and amyloidosis, while polyphenols have been widely studied for their potential to modulate protein aggregation pathways.

In this study, calorimetric and spectroscopic techniques, along with molecular docking, were employed to investigate the role of gallic acid (GA) in lysozyme (LYS) amyloid-like fibril formation. Differential scanning calorimetry (DSC) revealed a destabilizing effect of GA on the protein structure in Gly-HCl buffer, pH 2. Fluorescence spectroscopy was used to monitor LYS fibrillation and associated structural changes. Thioflavin T (ThT) assay reported the kinetics of β-sheet-rich fibril formation, while 8-anilino-1-naphthalenesulfonic acid (ANS) and Nile Red provided information on the exposure of hydrophobic regions during early aggregation. Congo Red absorption confirmed the presence of amyloid-specific cross-β sheet structures, supporting fibril formation in both the absence and presence of GA. GA modulates these processes in a concentration- and time-dependent manner, limiting early hydrophobic exposure and structural rearrangements at short incubation times, while promoting aggregation under prolonged incubation, highlighting its dual role in protein fibrillation. Molecular docking shown that GA binds to the native structure of LYS to form a stable complex, driven primarily by hydrogen bonding and hydrophobic interactions.

Understanding the modulatory effect of polyphenol on protein aggregation is crucial for the development of novel therapeutic agents targeting amyloid-related and other protein-misfolding disorders.

Acknowledgments: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS-UEFISCDI, contract number 93TE/03.01.2025, project code PN-IV-P2-2.1-TE-2023-0189, within PNCDI IV.

P-15. The Effect of Quercetin on Protein Aggregation

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Hemoglobin, a heme-containing tetrameric protein found in red blood cells, plays essential roles in oxygen transport, intracellular pH regulation, and various metabolic processes. Structural or functional alterations in hemoglobin are associated with disorders such as sickle cell disease, thalassemia, and anemia. Quercetin (QUER), a natural polyphenolic flavonoid present in tea and vegetables, exhibits antioxidant, anti-inflammatory, antiviral, and anticancer activities.

This study investigates the effect of different concentrations of QUER on bovine hemoglobin (BHb) thermal aggregation, under two incubation conditions (24 h at 277 K and 96 h at 310 K) using calorimetric, spectroscopic and computational methods. Differential scanning microcalorimetry (µDSC) results indicate a concentration-dependent effect at 277 K. Circular dichroism (CD) data reveal a predominant α-helix structure of protein, and minor conformational changes in the presence of QUER. In contrast, after incubation at 310 K, QUER promotes aggregation, evidenced by decreased α-helix content and increased β-structure. Dynamic light scattering (DLS) and Congo Red (CR) assay confirm the formation of larger aggregates and fibrillar structures. Molecular docking shows QUER binding within the central cavity of protein via hydrogen bonds and hydrophobic interactions. Overall, QUER exhibits a dual effect, stabilizing protein at low temperature and promoting aggregation under prolonged incubation at physiological temperature.

These findings provide insight into polyphenol–protein interactions with implications for protein stability, aggregation mechanisms, and potential biomedical applications.

Acknowledgments

This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS-UEFISCDI, contract number 93TE/03.01.2025, project code PN-IV-P2-2.1-TE-2023-0189, within PNCDI IV.

P-16. A Novel Sensitive Voltammetric Approach for Tartrazine Food Additive Detection

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Tartrazine is one of the most widely used food colorants, being present in a broad variety of products. Nowadays, it is a commonly used additive found in foods, beverages, pharmaceuticals, dietary supplements, cosmetics, toiletries, and other non-food products. Graphene material was prepared by electrochemical exfoliation at 12 V applied bias, in 0.05 M Ammonium sulfate/ 0.1 M boric acid/ 0.05M Sodium chloride mixed solution. The graphene-modified glassy carbon electrode was characterized and assessed for its selectivity, sensitivity, accuracy, and reproducibility through cyclic voltammetry (CV), Linear sweep voltammetry (LSV), and amperometric measurements. Graphene-modified electrodes are intensively used nowadays for the detection of tartrazine, a synthetic food dye, employed to color food products and beverages, making them more appealing for consummation. Such electrodes have several advantages, such as high surface areas coupled with a rapid transfer of electrons, higher sensitivities and lower detection limits in comparison with the unmodified electrodes. These graphene-modified electrodes are effective in determining tartrazine in commercial products like fruit juice, soft drinks, and food coloring with good recovery rates (98–104%).

Acknowledgments: This work was supported by the Ministry of Research, Innovation and Digitization through the 'Nucleu' Program within the National Plan for Research, Development, and Innovation 2022–2027, project number PN 23 24 03 01.

P-17. Valorisation of Agricultural Waste into Effective Sensing Materials for 2-Nitroaniline Assay

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The widespread use of nitro-aromatic compounds, particularly 2-nitroaniline (2-NA), has raised significant environmental and public health concerns due to their pronounced toxicity, persistence, and resistance to biodegradation. Consequently, the development of sustainable, cost-effective, and highly sensitive detection strategies for trace-level monitoring of such pollutants is of great interest. In this context, the present study introduces a green and innovative strategy for the synthesis of few-layer graphene through the direct electrochemical exfoliation of graphite in an unconventional environmentally friendly medium consisting of industrial waste potato juice supernatant (WPS), a by-product generated during starch production. This approach provides a sustainable alternative for graphene fabrication. The obtained material (WPS-Gr) was thoroughly characterized and further employed for the modification of a glassy carbon surface (WPS-Gr/GCE). The developed sensing platform exhibited remarkable electrocatalytic activity toward the reduction of 2-NA in phosphate buffer solution at pH 7, displaying a wide linear concentration range between 0.1 and 100 µM and a low detection limit of 60.6 nM. In addition, the modified electrode demonstrated excellent repeatability, good long-term stability, and high selectivity in the presence of structurally similar nitro-aromatic compounds and common inorganic interferents. The practical applicability of the proposed sensing protocol was successfully validated through recovery studies performed in real water samples.

Acknowledgments: This work was supported by the Ministry of Research, Innovation and Digitization through the ‘Nucleu’ Program within the National Plan for Research, Development, and Innovation 2022–2027, project number PN 23 24 03 01 and a grant from the Ministry of Research, Innovation and Digitization, CCCDI-UEFISCDI, project number 19PED/2025, within PNCDI IV. The authors are grateful to Paula Bulieris for providing waste potato juice supernatant, Bogdan Ionut Cozar and Septimiu Tripon for Raman and TEM/SEM measurements, respectively.

P-18. Rational designed multifunctional coatings for superhydrophobic surfaces using flower-like metal-oxide NPs.

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The multitude of applications that require water-repellent surfaces, with various properties, including self-cleaning and anticorrosive ones, still maintain this field of superhydrophobic surfaces as a topic of great interest in current research. Due to the complex morphology of natural surfaces, the lithographic methods used to mimic the leaf topography are expensive and time-consuming. To address these challenges, a suitable lab-scale strategy was developed to create synthetic hierarchical surfaces with tunable roughness, based on the synergistic combination of ZnO flower-like nanoparticles (ZnO NPs) embedded in a hybrid polymeric network based on organic-modified silica (ORMOSILs). To facilitate the production process and ensure its feasibility, a microwave-assisted approach was used to gain the ZnO NPs with a unique flower-like shape. Analysing these surfaces leads to the establishment of a dependency between ZnO NPs morphology and the primary wetting state, including strong influences on transition mechanisms between heterogeneous and homogenous wetting regimes. Also, inspired by the salvinia paradox, the concept of hydrophilic nano-patterns on a macro-scale superhydrophobic surface was explored, to observe if the plastron stability can be increased and, therefore, the metastable Cassie-Baxter state can be maintained for an extended period of time.

P-19. Synthesis, Characterization and Catalytic Efficiency of Biogenic AgNPs Derived from Artemisia absinthium

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Biogenic silver nanoparticles (AgNPs) are increasingly recognized for their multifunctional properties, including antimicrobial, antioxidant, antitumor, catalytic and metal ion detection activities, alongside a sustainable synthesis profile that favours applications in medicine and environmental remediation. Artemisia absinthium serves as a potent bioreductant due to its rich composition of terpenoids, flavonoids, and phenolic acids. The functional groups (-OH and -CO) within these phytocompounds play a dual role in the bioreduction of silver ions and the subsequent capping and stabilization of the resulting nanoparticles. In this study, AgNPs, were synthesized by mixing AgNO3 with an aqueous extract of Artemisia absinthium in two different volume ratios. The results indicate that the extract-to-AgNO3 volume ratio impacts the concentration of AgNPs. Initially, NPs formation was observed by a colour change in the reaction mixture from pale yellow to dark brown and subsequently confirmed by UV-Vis spectroscopy. The chemical composition and the morphological properties were studied using scanning electron microscopy (SEM) and Fourier-transform infrared spectroscopy (FTIR). Furthermore, the photocatalytic efficiency of the biosynthesized AgNPs was evaluated through the degradation of methylene blue under simulated solar irradiation. The effects of different parameters, such as catalyst concentration and solution pH, on the dye degradation rate were investigated. Moreover, scavenging tests were performed to elucidate the reaction mechanism by identifying which reactive species (holes, electrons, hydroxyl radicals, superoxide radicals) are responsible for the catalytic activity.

Acknowledgments: This research was supported by the Ministry of Research, Innovation, and Digitization, CNCS-UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0258, within PNCI IV program.

P-20. NIL-Fabricated Flexible 3D Nanotrenches as Tunable Substrates for High-Performance SERS Analysis

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The development of advanced sensing platforms based on micro- and nanostructured surfaces represents a pivotal strategy for the sensitive detection of molecular and biomolecular species, with applications in biomedicine and environmental monitoring. In particular, surface-enhanced Raman scattering (SERS) enables trace-level analysis of biomarkers in complex matrices, offering strong potential for minimally invasive diagnostics and early-stage disease detection. We report the development of flexible, plasmonic SERS substrates based on arrays of 3D nanotrenches fabricated through nanoimprint lithography (NIL). By varying the grating pitch (300 nm and 600 nm), we optimized the structural parameters for enhanced Raman scattering. The metallization with gold (Au) thicknesses of 15 nm, 25 nm, 60 nm and 100 nm was made using magnetron sputtering deposition technique (MS). Structural characterization by scanning electron microscopy (SEM) confirmed the high fidelity of pattern transfer, as well as the uniformity and reproducibility of the fabricated nanostructures. The SERS performance of the substrates was evaluated using crystal violet (CV) as a model analyte over a concentration range of 10-2–10-10 M. Thinner Au films (15–25 nm) provided enhanced signal amplification and lower detection limits, while increased thickness lead to reduced sensitivity due to diminished hotspot density. The optimized SERS substrates exhibited high sensitivity and reproducibility, demonstrating strong potential for integration into scalable sensing platforms.

Acknowledgements: This work was supported through the "Nucleu" Program within the National Research Development and Innovation Plan 2022–2027, Romania, carried out with the support of MEC, project no. 27N/03.01.2023, component project code PN 23.24.01.02.

P-21. Portable SERS-based Platform for Sensitive Detection of Biotoxins in Freshwater Systems

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As anthropogenic pollution continues to fuel cyanobacterial proliferation in freshwater, implementing rapid and reliable detection methods has become a critical public health priority. Optical sensing methods, particularly based on surface-enhanced Raman scattering (SERS), offer exceptional sensitivity for trace-level analysis of hazardous biomolecules, making them suitable candidates for environmental monitoring applications. Here we describe the design of a compact, portable sensing platform tailored for in situ detection of biotoxins. The architecture was developed using computer-aided design tools, enabling precise definition of component geometry, device layout, and operational parameters such as sample handling volume and structural integration. The developed CAD models enabled precise verification of geometric tolerances, alignment accuracy, and inter-component compatibility. The proposed demonstrator integrates nanostructured SERS-active substrates fabricated via Nanoimprint Lithography (NIL) combined with Magnetron Sputtering (MS), ensuring high surface uniformity and signal enhancement. SEM images validates the quality, uniformity, and reproducibility of the nanostructures, while also revealing the distinct growth mechanisms of Ag films, thereby identifying the configurations with the highest potential for SERS enhancement at ultra-low concentrations. The analytical performance of the platform was validated using a portable Raman spectrometer and model analytes to assess sensitivity and spectral reproducibility. The results highlight the potential of the developed system as a versatile and field-deployable solution for real-time monitoring of water quality, with particular relevance to early detection of biotoxin contamination in stagnant freshwater environments.

Acknowledgements: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CCCDI - UEFISCDI, project number PN-IV-P7-7.1-PED-2024-0052, within PNCDI IV.

P-22. Optimization of Water Extraction for Isotopic Analysis: Comparison between Centrifugation and Cryogenic Distillation

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Fraudulent practices such as mislabelling imported meat as locally sourced undermine consumer trust and threaten the integrity of local brands. Verifying the geographical origin of meat is essential to ensure that products sold under a regional label are authentic and compliant with food safety standards. This study evaluates the geographical origin of meat based on the isotopic composition of water (δ^2H and $\delta^{18}O$) previously extracted from meat samples. In meat products, the isotopic composition of tissue water reflects both the consumed water and feed. The δ^2H and $\delta^{18}O$ values can provide information about the geographical region where the animal was raised, offering insights into the origin of the meat. Because isotopic fractionation during the water extraction process can significantly affect the final results, the primary objective was to compare two extraction techniques: centrifugation versus cryogenic distillation.
For this, 64 samples of pork loin and 58 samples of pork leg were finely minced and divided into subsamples of different masses. Then, samples were processed using the two water extraction methods, assessing which approach provides better reproducibility and repeatability. The isotopic differences obtained between the methods, emphasize that isolating the entire water content is vital for accurate qualitative assessment of origin. The most robust method for the accurate measurement of the isotopic composition of the extracted water from meat, was identified.

This paper was co-financed by the European Regional Development Fund (ERDF) through the Smart Growth, Digitization and Financial Instruments Program (PoCIDIF), call PCIDIF/159/PCIDIF_P1/OP1/RSO1.1/PCIDIF_A1.1, Project SMIS number 329011.

P-23. Microfluidic Approach for Size-Controlled Liposomes Loaded with Doxorubicin Using Passive and Active Loading

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Doxorubicin (Dox) is one of the most widely used therapeutic agents for cancer treatment. It was the first anticancer drug successfully encapsulated into liposomes, that is, Doxil®, which is used for breast cancer, Kaposi's sarcoma, multiple myeloma, and ovarian cancer.[1] Doxil is produced by thin-film hydration (TFH) followed by extrusion to control liposome size, with drug encapsulation achieved using an ammonium sulfate gradient. Microfluidic approaches allow enhanced control of liposome size and enable more efficient encapsulation of Dox compared to conventional TFH.[2,3] Herein, 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC)/cholesterol (2.3:1 molar ratio)-based liposomes were prepared and mixed with Dox dissolved in PBS (10 mM, pH 7.4) using a herringbone microfluidic chip (Elveflow system). A total flow rate (TFR) of 4400 µL/min and a flow rate ratio (FRR) of 10:1 were used to produce Dox-loaded vesicles. Unencapsulated Dox was removed using Amicon centrifugal filtration, resulting in a loading degree (LD) of 1.93% for this passive approach. To enhance the loading efficiency, purified ammonium sulfate-loaded liposomes were incubated with Dox solution for 1h to promote active loading. The resulted purified liposomes exhibited a significantly higher loading efficiency of 12.93% Dox. All vesicles were characterized for the Z-average diameter and polydispersity index (PDI). Passive loading yielded liposomes with an average size of 55.47 nm and a PDI of 0.37, whereas active loading produced smaller and more homogeneous vesicles with a size of 46.67 nm and a PDI of 0.2871. Lipid quantification using the Stewart assay showed that most liposomes are recovered (RF = 91.5%) after purification.

Acknowledgment: This work was supported by an H2020–ERA-Chair project, GA number 952390/2020 and PN-IV-PCB-RO-MD-2024-0363 funded by UEFISCDI.

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P-24. The Interaction of Transition Metal-Doped Magnetic Nanoparticles with Plasma Proteins

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Adsorption of plasma protein onto magnetic nanoparticles (MNPs) represents a critical interfacial process that significantly affects their biological performance in physiological environments, in terms of colloidal stability, biodistribution, circulation lifetime and immunological responses [1-2]. This study evaluates the adsorption of two plasma protein, namely fibrinogen (Fb) and bovine serum albumin (BSA) on different types of magnetic nanoparticles, specifically iron-oxide NPs and doped iron-oxide NPs with Co, Mn, and Zn (10%). The nanoparticles were synthesized via the coprecipitation method using Pluronic F127 as a dispersing agent. VSM analysis confirmed that all nanoparticles exhibit superparamagnetic behaviour. The formation of a cubic spinel structure was proved by XRD patterns. TEM imaging revealed a predominantly spherical morphology characterized by narrow size distributions and average particle size between 12 and 25 nm. Zeta potential values varied from –16.12 to +35 mV, reflecting good colloidal stability across the sample set. MNPs were first diluted in plasma simulated body fluid (SBF, pH = 7.4). Next, the proteins in SBF were mixed with MNPs dispersions followed by incubation under gentle stirring at 37 °C. At various time intervals, the quantity of adsorbed protein was spectrophotometrically evaluated. An influence of the dopant on the adsorption performance was noticed, with Zn promoting a decreased protein adsorption. Considering the role of Fb into coagulation process, its low adsorption shows that MNPs do not influence the blood coagulation, which should be confirmed by additional investigations.

Acknowledgment: This work was supported by an H2020–ERA-Chair project, GA number 952390/2020.

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P-25. ^{15}N-Isotopic Labeling of Arthrospira platensis for Advanced Metabolic Tracers: Analytical and Biophysical Optimization

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In translational nanomedicine, isotopically enriched biomolecules are essential for elucidating complex metabolic pathways and enhancing diagnostic precision. This study presents the systematic isolation and preliminary characterization of protein fractions from Arthrospira platensis (Spirulina), cultivated under controlled conditions at INCDTIM, with the aim of generating 15N-labeled biomolecular systems.

Our methodology enabled the extraction of two primary pools: a water-soluble fraction enriched in phycobiliproteins—specifically phycocyanin—and a water-insoluble fraction containing photosynthetic pigments such as chlorophyll a. UV–VIS spectrophotometry confirmed the characteristic absorption profiles of these biomolecular fractions. To optimize recovery, we implemented a fractional ammonium sulphate precipitation protocol, yielding an 88% recovery rate of phycocyanin in micro-scale trials. These results demonstrate the efficiency of the method for concentrating targeted proteins and suggest scalability for larger extract volumes, provided rapid processing follows cellular lysis.

While these fractions are currently crude biomolecular mixtures, they serve as a robust foundation for the subsequent purification and isotopic characterization of individual components. Such 15N-labeled protein systems hold significant potential as metabolic tracers and isotopic markers in biochemical and clinical research. By bridging the gap between bio-analytical precision and clinical utility, this work offers a viable pathway for developing innovative diagnostic tools, transforming molecular insights into tangible clinical impact within the framework of translational medicine.

Acknowledgments:
The authors acknowledge financial support from the MCID through the "Nucleu" Programme within the National Plan for Research, Development and Innovation 2023-2026, project PN23 24 01 05 and through the Installations and Special Objectives of National Interest (IOSIN), IZOSTAB.

P-26. Sustainable Electrochemical Platforms Based on Stone Paper and Modified with Activated Coffee Waste Biochar for Advanced Analytical Sensing

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In line with the principles of Green Analytical Chemistry, this study explores the development of sustainable electrochemical sensing platforms by valorizing agricultural waste on eco-friendly substrates. We report the modification of screen-printed electrodes (SPEs) fabricated on stone paper (a mineral-rich, tree-free alternative) using biochar derived from spent coffee grounds.

The research investigates the influence of two separate activation protocols on the biochar's performance: a two-step thermochemical activation under CO2 to enhance the porous framework, and a chemical activation with HNO3 to functionalize the surface. Following these activations, the material's properties were further explored through the adsorption of Cr (VI), which served as a surface modifier and redox probe.

The electrochemical behavior was rigorously evaluated using cyclic voltammetry (CV) to determine the electroactive surface area and electron transfer kinetics. The results demonstrate that the combination of targeted chemical activation and the stone paper's robust support significantly increases the active area and sensitivity compared to unmodified biochar. This approach provides a low-cost, disposable, and "green" alternative to conventional electrodes, proving that the synergy between waste-derived materials and sustainable substrates can yield high-performance analytical tools for environmental monitoring and beyond.

Acknowledgments:
The authors acknowledge financial support from the MCID through the "Nucleu" Programme within the National Plan for Research, Development and Innovation 2023-2026, project PN23 24 01 05, the Ministry of Research, Innovation and Digitization, CNCS/CCCDI—UEFISCDI, projects number PN-III-P1-1.1-TE-2021-0358, and through the Installations and Special Objectives of National Interest (IOSIN), IZOSTAB.

P-27. Eco-friendly Nanomaterials Towards the Specific Detection of "Forever Chemicals"

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The advancement and functionalization of novel nanomaterials provide a pathway for high-specificity trace detection of environmental contaminants. Among these, per- and polyfluoroalkyl substances (PFAS), often termed "forever chemicals" remain persistent in food and water supplies. PFAS detection poses a challenge due their extreme stability (C-F bonds), amphiphilic nature and bioaccumulation potential. Thus, biological gold nanoparticle (b-AuNP) synthesis provides tailored nanoparticles' functionality, while lowering energy requirements, the use of harmful chemicals and production costs [1]. Perfluorooctanesulfonic acid (PFOS) was chosen as one of the most common PFAS. Various b-AuNP modified electrochemical sensors were implemented for specific PFOS detection, where drop-casting on carbon-based screen-printed electrodes demonstrated an LoD of 0.43 nM (0.21 µg/L). These levels do not yet meet the stringent regulatory benchmark of 0.02 µg/L for PFOS, however, other surface modification methods using b-AuNPs showed promising results in laboratory conditions.

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Acknowledgments

This work was supported by a grant from the Romanian Ministry of Research and Innovation, CNCS - UEFISCDI, project number PN-III-P1-1.1-PD-2019-1285 within PNCDI III.

P-28. Comparative study of the isolation of quercetin from blueberry leaf and onion leaf

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Flavonoids are secondary metabolites of plants, with an important role in modulating oxidative processes in biological and food systems.

Blueberries are rich in various bioactive constituents, including flavonoids, phenolic acids, and terpenoids, exhibiting multiple pharmacological activities, such as antibacterial, anti-inflammatory, antioxidant, antitumor, hypoglycemic, and hypouricemic. Quercetin and kaempferol, the main flavonoids in onions (Allium cepa L.), present beneficial effects on health, having multiple activities such as antitumor, antioxidant, anti-inflammatory, antithrombotic. [1]

We aimed to isolate and identify quercetin from blueberry leaf and yellow onion leaf extracts, in order to demonstrate its antioxidant activity.

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P-29. Design and Synthesis of Novel Antitumor Pyrazole Heterocyclic Dyes

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Pyrazole compounds have been the subject of extensive research due to their biological applications, as antibacterial, antitumor, anti-inflammatory, antidiabetic, local anesthetic agents, having an essential role in the field of organic chemistry, medicinal chemistry. [1-3]

The chemistry of heterocyclic azo dyes is of particular interest because they have applications in various industrial fields, such as biomaterials, photosensitive materials, nonlinear optics, and photoelectronics. [4]

A series of new azopyrazole compounds were synthesized and characterized by IR, 1H-NMR, 13NMR, UV-Vis spectrometry and tested in vitro for their antitumor activity.

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P-30. Dual Fluorescence Of 1,3,4-thiadiazole Derivatives Confined In Polymeric Films: A Supramolecular Perspective

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Functional polymeric films with tunable optical properties are of growing interest in modern materials chemistry. Among them, 1,3,4-thiadiazole derivatives represent a versatile class of electron-deficient chromophores exhibiting diverse photophysical behaviors, including charge-transfer and aggregation-induced emission.

Here, we investigate polymeric films doped with selected thiadiazole derivatives using a combined spectroscopic approach (UV–Vis, steady-state and time-resolved fluorescence, RLS, fluorescence anisotropy, and FTIR) to relate molecular organization to optical response. The incorporation of thiadiazole luminophores leads to pronounced dual fluorescence with emission bands at ~430 nm and ~530 nm, in contrast to single-band emission in dilute solutions. The short-wavelength emission originates from monomeric species, while the long-wavelength band is associated with aggregated forms stabilized by hydrogen bonding and π–π interactions. DFT and TD-DFT calculations confirm that different aggregate geometries produce distinct emissive states, explaining the observed dual emission. These results highlight the key role of aggregation-induced emission (AIE), with the polymer matrix promoting stabilization of emissive aggregates.

Overall, this study establishes a direct link between supramolecular organization and emission properties, providing a framework for designing polymer-based materials with controllable optical responses relevant for sensing, bioimaging, or optoelectronic applications.

P-31. A DFT–Based Study and ADMET Evaluation Of Small Heterocyclic Compounds With Antimicrobial Activity

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Microbial resistance represents a critical challenge in clinical practice, and the discovery of novel effective compounds against multidrug-resistant pathogens is a major focus of contemporary biomedical research. Five- and six-membered heterocyclic compounds containing one or two heteroatoms play a central role in medicinal chemistry; therefore, the design and development of new heterocyclic derivatives remain essential. Recent studies have shown that hybrid molecules incorporating two or more heterocyclic rings exhibit enhanced biological activity compared to simple heterocycles. In this context, density functional theory (DFT) studies represent an important tool in the rational design of novel antimicrobial hybrids.

In the present work, DFT calculations were carried out on a series of heterocyclic compounds, and correlations between molecular and geometric parameters and their antibacterial and antifungal activities were established. In addition, ADMET analysis contributed to the characterization of the pharmacokinetic profiles of the investigated compounds, supporting their potential as new therapeutic agents.

Methylene, amino, diazo, or carbonyl bridges between the two heterocyclic rings typically increase the biological activity according to SAR studies. It has been demonstrated that the presence of saturated heterocyclic substituents, such as morpholine or piperazine, as well as methoxy and methyl groups on a heterocycle or phenyl ring, is very advantageous for a variety of anticancer compounds. The S=O group between the two cores of pyrimidine and benzimidazole, the grafted alkyl groups—particularly the n-propyl to the pyrimidinone nitrogen—and the substituents -OCH3 and -OCF3 from the “5” position of the benzimidazolic ring are noted as being crucial for enhanced therapeutic activity.

P-32. Synthesis, ADMET Evaluation And Antibacterial Activity of Selected Pyrimidine Compounds

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The pyrimidine ring has been highlighted in recent literature for its derivatives exhibiting diverse therapeutic activities, including antimicrobial, antiviral, antitumor, antidiabetic, and anti-Alzheimer effects. Among the strategies for synthesizing pyrimidine derivatives, multicomponent reactions like the Biginelli synthesis are widely used. Here, we applied the reaction using an aldehyde, urea/thiourea/guanidine, and ethyl acetoacetate or methyl cyanoacetate as starting materials.
Structural confirmation of the pyrimidine derivatives was achieved through NMR, FTIR, and mass spectrometry analyses.
ADMET studies were conducted on the synthesized compounds, providing essential pharmacokinetic data for drug development. Qualitative assessment of the antimicrobial activity using the Kirby-Bauer diffusion method indicated moderate effects against Staphylococcus aureus and Escherichia coli, with toxicities remaining within acceptable limits for medicinal use.

P-33. Green-Fluorescent Carbon Dots Based on Protocatechuic Acid and Branched PEI for in vitro Imaging and Gene Delivery

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Carbon nanodots (CNDs) have gained significant attention as effective tools for bioimaging and gene delivery owing to their strong photostability, biocompatibility, and adjustable optical characteristics. In this work, green-emissive CNDs were prepared through a microwave-assisted synthesis approach using protocatechuic acid (AP) and high-molecular-weight branched polyethyleneimine (bPEI25kDa) as starting materials. The synthesized AP-PEI25k CNDs displayed a uniform spherical shape with an average diameter of 9 nm, along with intense photoluminescence focused at 520 nm, corresponding to green emission. They also exhibited high colloidal stability in aqueous media and a positive surface charge, which promotes electrostatic binding with negatively charged plasmid DNA.

Stability studies indicated high resistance to photobleaching, temperature variations, and a wide pH range. The CNDs efficiently condensed plasmid DNA and offered partial protection against enzymatic degradation. Furthermore, they exhibited minimal nonspecific adsorption of serum proteins. In vitro investigations using HeLa and HGF cell lines demonstrated effective gene transfection with reduced cytotoxicity, as evidenced by higher IC_{50} values compared to bPEI25kDa alone. In addition, fluorescence microscopy confirmed the cellular internalization and intracellular distribution of the CNDs in HeLa cells.

Overall, these findings indicate that AP-PEI25k CNDs represent promising multifunctional nanoplatforms for further investigation in in vivo applications involving combined gene delivery and bioimaging.

Acknowledgments

This work was financially supported by a grant from the National Research Authority, project no. PNRR-III-C9-2022-I8-291, IntelDots, contract no. 760081/23.05.2023, within the National Recovery and Resilience Plan.

P-34. Exploiting the CAM assay as a rapid in vivo preclinical platform for tumor modeling

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Tumor progression and therapeutic response are strongly influenced by the dynamic interplay between cancer cells and the tumor microenvironment (TME), including extracellular matrix (ECM) remodeling. However, the development of rapid and reliable in vivo preclinical models that faithfully recapitulate these processes remains a major challenge.

The chick embryo chorioallantoic membrane (CAM) represents a robust, cost-effective, and highly vascularized platform enabling the functional evaluation of tumor growth and response to therapeutic interventions in a physiologically relevant context.

Here, we propose the CAM assay as a versatile in vivo preclinical model to investigate tumor engraftment, angiogenesis, and ECM remodeling in response to defined molecular perturbations and candidate therapies, including RNA-based approaches. Tumor cell models are grafted onto the CAM, allowing real-time assessment of tumor growth, vascular recruitment, and matrix reorganization.

By integrating histological analysis, immunofluorescence, and label-free second harmonic generation (SHG) imaging, we quantitatively characterize TME remodeling, ECM dynamics, and tumor progression. This approach enables rapid screening of therapeutic effects on tumor vascularization and growth.

Overall, the CAM system provides a powerful in vivo preclinical platform bridging mechanistic studies and translational applications, facilitating the identification and validation of novel targets involved in tumor–microenvironment interactions and treatment response.

P-35. Heavy metals in soil and Vitis vinifera L. – Assessment of the impact on human health

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Abstract. The concentration of heavy metals in soil and Vitis vinifera L. plant tissues, as well as the assessment of phytoremediation capacity and health risk indices, was reported in this work. The high levels of Cd, Cu, Zn, Pb, and Zn in the plant tissues of V. vinifera and the high levels of Cd, Cu, Zn, and Fe in soil samples demonstrate the need to assess the dangers of environmental contamination in the ecosystem where these species are growing.

The Pearson correlations between heavy metals in soil samples indicate that the complex Cd–Pb–Mn has a common source: pesticides. For all age groups (adults, children, and teenagers) the carcinogenic risk exhibits the threshold in the case of Pb, although estimated daily intake, chronic daily intake, hazard quotient, and hazard index have values below the maximum threshold set. In the case of Cu, Pb, and Mn, the health risk index for children has been found to be higher than the recommended threshold.

Keywords: soil; grapevine; heavy metals; statistical analysis; phytoremediation capacity; risk index.

P-36. Assessment of the nutritional quality of infant complementary foods in Romania and their contribution to mineral intake

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This study aims to: (i) determine the concentrations of essential elements (Na, Mg, K, Ca, Mn, Fe, Cu, Zn, and Se) in infant complementary food, and (ii) estimate of the total daily intake of these minerals for infants aged 4-6, 7-9, and 10-12 months. These findings will be evaluated taking into account: (i) the mineral content of investigated complementary foods, (ii) the mineral contribution of breast milk, according to a proposed dietary regime in this study. Total daily mineral intake values were compared with the recommended daily intake (RDI) to assess whether current dietary practices meet the mineral requirements of infants. Although this study focuses on the Romanian market, its implications extend globally, as many countries face similar challenges with commercial complementary food products. The results contribute to worldwide initiatives aimed at guaranteeing nutritionally sufficient and safe feeding methodologies during the infancy period.

Acknowledgments. This work was supported by the MCID through the "Nucleu" Programme within the National Plan for Research, Development and Innovation 2022-2027, contract No. 27N/2023, PN 23 24 03 01.

P-37. Risk assessment of polycyclic aromatic hydrocarbons and potentially toxic elements in traditionally smoked meat

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In the present study, the levels of polycyclic aromatic hydrocarbons (PAHs) and potentially toxic elements (PTEs) in smoked pork samples were investigated, with the primary aim of assessing their potential non-carcinogenic and carcinogenic risks to human health using several risk assessment indices, including Estimated Daily Intake (EDI), Target Hazard Quotient (THQ), Hazard Index (HI), Incremental Lifetime Cancer Risk (ILCR), and Margin of Exposure (MOE). Sensitivity analysis revealed that the consumption rate represents the most important modifiable risk factor from the consumer perspective. The evaluated risk indices showed a direct linear relationship with consumption, such that a doubling in consumption resulted in a proportional doubling of all risk indicator values. At elevated consumption levels (100-150 g/day), which may be characteristic of traditional dietary patterns in certain populations, even moderate contamination levels approached critical thresholds. This finding highlights the need both to moderate consumption, particularly among vulnerable groups and frequent consumers, and to optimize the smoking process.

Acknowledgments. This work was supported by the project “Project for transfer to the economic operator (PTE), contract no. 36PTE/2025”, financed by the Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI), within the framework of the National Plan for Research, Development and Innovation (PNCDI).

P-38. Risk analysis of heavy metals contamination in riverine fish from Aries River, Romania

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Environmental pollution, driven by industrialization and human activity, particularly impacts ecosystems and human health. Heavy metal contamination poses significant risks as these non-biodegradable elements accumulate in the environment due to both natural processes and anthropogenic sources such as industrial activities and mining. Aquatic life, particularly fish, experiences significant bioaccumulation in rivers, posing potential health risks to humans who consume contaminated fish.

The Aries River, previously impacted by mining activities, is under study for heavy metal concentrations in fish species. The research aimed to quantify metal levels in fish tissues and assess health risks from consumption.

The study aims to determine safe consumption levels of fish and identify pollution sources, employing metrics like the metal contamination index and health risk assessments including estimated daily intake (EDI), target hazard quotient (THQ), and carcinogenic risk.

The THQ and HI values for elements in the analyzed samples were determined to be below 1, indicating that there is no substantial non-carcinogenic health risk linked to the absorption of heavy metals through the consumption of the examined fish.

Acknowledgments. This work was supported by a grant from the Ministry of Research, Innovation and Digitization, CCCDI—UEFISCDI, project number 19PED/2025, within PNCDI IV

P-39. Human health risk evaluation in potatoes from Romania

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Potatoes are a staple food consumed worldwide, but contamination with pesticides and heavy metals poses potential risks to human health. In this study, 50 potato samples were analysed, including commercial varieties and locally produced ones from Transylvania, Romania.

Inductively coupled plasma mass spectrometry (ICP-MS) and gas chromatography with flame ionization detection (GC-FID) were used to quantify heavy metal content and pesticides.

The main objectives were to determine the levels of pesticide and heavy metal residues in these samples and to assess the associated risks to human health from their consumption. By integrating advanced analytical techniques with risk assessment models, the study provides valuable information on food safety and supports the development of strategies to minimize exposure to contaminants in agricultural products. The human health risk assessments indicated potential risks from chronic exposure, especially from pesticides and certain heavy metals.

This research provides a comprehensive assessment of the contamination of potatoes - a staple food in Romania - with pesticides as well as heavy metals, along with the related implications for human health.

Acknowledgments. This work was supported by the MCID through the "Nucleu" Programme within the National Plan for Research, Development and Innovation 2022-2027, contract No. 27N/2023, PN 23 24 03 01.

P-40. Nanopore Electrophysiology Reveals Spatial Determinants of Hg2+ - Induced DNA Self-Duplexes

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Metal ions play essential roles in nucleic acid chemistry, modulating structural stability, folding kinetics, gene regulation, and catalytic activity. Beyond their physiological role, metal-DNA interactions can induce conformational transitions that can drive to cellular responses to metal exposure. Notably, the mercuric ion (Hg2+) exhibits high specificity for thymine residues, facilitating the formation of non-canonical T–Hg^{2+}–T base pairs and effectively stabilizing mismatches within a DNA duplex.

Herein, using a single-molecule nanopore electrophysiology detection technique we examined the Hg2+ - mediated stabilization in self-DNA duplexes that are otherwise thermodynamically unstable. We engineered two short DNA fragments containing different numbers and positions of thymine residues and monitored their behaviour in an α-HL nanopore in the presence and absence of Hg2+.

Out findings reveal that the unzipping dynamics of such self-DNA duplexes is significant position-dependent on the metal-mediated base pairs: central Hg2+ - coordinated clusters are readily unzipped, whereas terminal T–Hg^{2+}–T pairs confer exceptional structural rigidity, resisting dissociation even under a high electrophoretic force.

The distinct responses of the two DNA constructs highlight the importance of sequence context and thymine positioning in metal-mediated base pairing. These insights advance the understanding of mercury–DNA interactions and support the design of metal-responsive nucleic acid structures for sensing and nanotechnology.

Acknowledgments: This investigation was conducted in a facility hosted by the Laboratory of Molecular Biophysics and Medical Physics, Faculty of Physics, 'Al. I. Cuza' University, Iasi'. This work was supported by a grant of the "Alexandru Ioan Cuza" University of Iasi, Romania, within the Research Grants program, Grant UAIC, code GI-UAIC-2023-01.

P-41. Novel Carbopol Based Hydrogel with Antibacterial Activity for Burn Therapy

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Functionalized hydrogels allow an accelerated wound healing process, due to their combined properties, such as: biodegradability, adhesion, antimicrobial activity; they ensure a relatively constant therapeutic concentration at the wound site, through the prolonged release of functional compounds. Ethyl 6-methyl-4-(naphthalen-2-yl)-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate is a dihydropyrimidine compound (2-naphthyl-DHPM derivate), which have many biological properties, such as: antibacterial, antiviral, and anti-inflammatory activities, calcium antagonist, or anticancer potential.

The purpose of this study is to evaluate the antibacterial potential of the hydrogel functionalized with 2-naphtyl-DHPM derivate, obtained by the Biginelli synthesis. Carbopol hydrogels containing glycerol were formulated with pyrimidine derivative and bacitracin, respectively.

Two working methods were used: for liquid formulas (1/10 m/V dilutions) the adapted Kirby-Bauer diffusimetric antibiogram method, and for hydrogel formulas the method of drawing lines of gel on plates inoculated with the bacterial strains. Reference bacterial strains of S. aureus, E. coli, and P. aeruginosa were used. The antibacterial effect of the hydrogels was quantified by observing the inhibition of microbial growth in the contact area with the functionalized gels.

The developed hydrogels combined good biocompatibility with antibacterial activity. Therefore, further in vivo studies were performed on burn wounds in rats, where the derivate showed results similar to those of bacitracin.

Acknowledgements: This work was supported by the sectoral research-development plan project of the Ministry of National Defence „Innovative pharmaceutical preparations with topical administration and antimicrobial activity based on new synthetic hybrid compounds".

P-42. Dextran-Based Preparation of Hybrid Gold-Magnetic Nanoparticles for SERS Detection of Environmental Contaminants

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Magnetic nanoparticles have attracted significant interest for environmental applications due to their unique physicochemical properties and magnetic separability.

In this work, magnetic nanoparticles were first synthesized by coating magnetite (Fe_3O_4) cores with dextran through a co-precipitation method. Dextran acted as a biodegradable stabilizing agent, improving colloidal stability and providing reactive groups for further functionalization.

Next, dextran-coated nanoparticles were functionalized with guanosine through benzene-1,4-diboronic acid linker, followed by gold deposition through guanosine quartet formation in the presence of Au^+ ions. This process generated worm-like gold nanostructures on the magnetic nanoparticles surface, resulting in hybrid magnetic-plasmonic nanoparticles.

The obtained materials were characterized by dynamic light scattering (DLS), transmission electron microscopy (TEM), X-ray diffraction (XRD), and UV-Vis spectroscopy. Their surface-enhanced Raman scattering (SERS) performance was evaluated using methylene blue as a model analyte. The results demonstrated a concentration-dependent enhancement of Raman signal intensity, confirming the suitability of the synthesized nanoparticles as SERS-active substrates for the sensitive detection of environmental contaminants.

The obtained results highlight the potential of these hybrid nanostructures as reusable SERS substrates for the sensitive detection of environmental contaminants and environmental monitoring applications.

This work was financially supported by a grant from the National Research Authority, project no. PNRR-III-C9-2023-I8-161, MultiPodGaN, contract no. 760285/27.03.2024, within the National Recovery and Resilience Plan.

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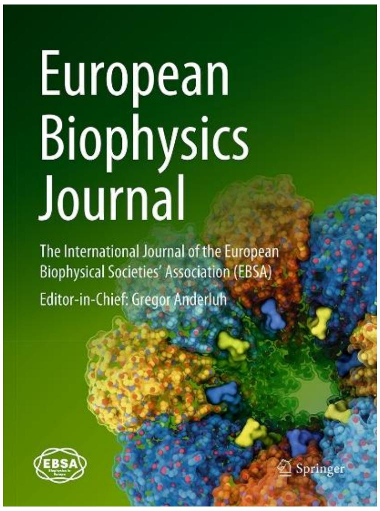

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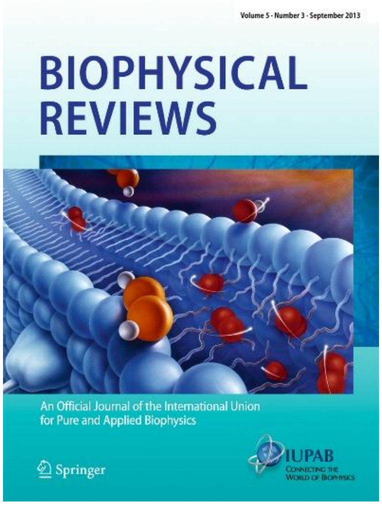

Volume 5 · Number 3 · September 2013

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