

# ABSTRACT BOOK

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**EEC**

**Conference**

**2025**

**1st International Conference**

**Emerging Environmental Contaminants -  
Current Status, Challenges and Perspectives**

**Rzeszów, Poland**

**April 9-10, 2025**

## **Dear colleagues, the participants of the 1st „Emerging environmental contaminants – current status, challenges and perspectives” conference**

Environmental pollution is one of the greatest challenges that we face today. Agrochemicals, pharmaceuticals, heavy metals, personal care products, microplastics, and industrial chemicals represent the main chemical groups of these pollutants. Many of them are classified as contaminants of emerging concern. Also biological contaminants could be a threat to human health.

During this conference, we will focus on sources, occurrence, and monitoring of environmental pollutants, their impact on human health and ecosystems, as well as on remediation methods. The aim of the conference is to present the current state of knowledge and share experiences in those fields. Additionally, the organizers' intent is to stimulate and integrate the academic community, and to create a place that encourages sharing of ideas and information. The conference will also provide an ideal setting for developing new cooperation and meetings with experts.

I am glad that this event has brought together such great experts and scientists from around the world. I cordially wish you interesting lectures and fruitful discussions with scientists and experts. May this event become an opportunity for establishing scientific cooperation, in order to create a safer environment for all of us.



Ewa Szpyrka  
The Chair of the Scientific Committee

Rzeszów, April 9, 2025

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# The program of Emerging Environmental Contaminants – Current Status, Challenges and Perspectives Conference

Wednesday, 9 April 2025 – Day 1

University of Rzeszów, Rejtana 16c St., Building A1  
Saint Jadwiga Hall on the ground floor

9:00	REGISTRATION
10:00	Opening and Welcome <b>Prof. Adam Reich, MD, PhD</b> , University of Rzeszów
<b>Session 1</b>	
<b>Chair:</b> <b>Ewa Szpyrka, Idalia Kasprzyk</b> , University of Rzeszów, Poland	
10:20	<b>Keynote lecture:</b> The health impacts of microplastics <b>Joana C. Prata</b> , CESPU, Gandra, Portugal
10:55	<b>Keynote lecture:</b> Importance of Applying New Approach Method in Pesticide Risk Assessment <b>Zisis Vryzas</b> , Aristotle University of Thessaloniki, Thessaloniki, Greece
11:30	COFFE BREAK
<b>Session 2</b>	
<b>Chair:</b> <b>Donát Magyar</b> , National Center for Public Health and Pharmacy, Budapest, Hungary <b>Katarzyna Kluska</b> , University of Rzeszów Rzeszów, Poland	
12:00	<b>Keynote lecture:</b> Green sustainable algae-bacteria combine approach to handle the current water environmental emerging contaminants challenges <b>Mohammad Russel</b> , Dalian University of Technology, Dalian, China
12:35	One health perspective on dietary exposure and health implication – rare earth elements (REE) in the environment <b>Andrzej R. Reindl</b> , Gdansk Medical University, Gdańsk, Poland
12:55	Assessment of consumer exposure to selected pesticide residues in fresh food <b>Maciej Tankiewicz</b> , Gdansk Medical University, Gdańsk, Poland
13:15	Ambitious climate protection and recycling targets as a threat to maintaining a high level of environmental protection as a whole <b>Andrzej Kulig, Monika Maziarz, Iwona Rachowicz</b> Marshal's Office of the Podkarpackie Region, Rzeszów, Poland
13:30	LUNCH
<b>Session 3</b>	
<b>Chair:</b> <b>Magdalena Podbielska</b> , University of Rzeszów, Poland <b>Łukasz Jurczyk</b> , University of Rzeszów Rzeszów, Poland	
14.30	Lessons learned from regulating pollen emissions in Hungary using the potential allergenicity index (CARE-S) <b>Donát Magyar</b> , National Center for Public Health and Pharmacy, Budapest, Hungary
14:45	Aerobiology – automatic realtime sampling and analysis of airborne pollen grains and fungal spores <b>Branko Sikoparija</b> , BioSense Institute, Novi Sad, Serbia
15:00	Microplastic pollution in surface waters and sediments of multiple lakes in Türkiye: preliminary findings <b>Sedat Gundogdu</b> , Cukurova University, Saricam/Adana, Turkey
15:15	Sample preparation for environmental samples – challenges and solutions <b>Grzegorz Pluta</b> , Altium International Sp. z o. o., Poland
15:30	New methods for microplastic extraction and sample preparation for LDIR analysis <b>Wojciech Strojny</b> , Rzeszów University of Technology, Rzeszów, Poland
15:45	Pyrolysis GC-MS in the identification of microplastics <b>Karen Sam</b> , CDS, USA
16:15	COFFE BREAK
16:15-17:00	Poster Session

## Thursday, 10 April 2025 – Day 2

University of Rzeszów, Rejtana 16c St., Building A1  
Saint Jadwiga Hall on the ground floor

### Session 4

**Chair:** **Zisis Vryzas**, Aristotle University of Thessaloniki, Thessaloniki, Greece,  
**Małgorzata Kus-Liśkiewicz**, University of Rzeszów, Poland

9:00	From Wastewater to Snow: a water pathway of antimicrobials and their effect on gram-negative bacterial resistance <b>Natalia Czernecka, Anna Ratajewicz</b> , University of Agriculture in Krakow, Kraków, Poland
9:15	Recent Insights into Particulate Matter. Cytotoxicity assessment of air pollution particles in podkarpackie region <b>Małgorzata Kus-Liśkiewicz</b> , University of Rzeszów, Rzeszów, Poland
9:30	Airborne nano- and microplastics as emerging environmental contaminants: distribution, atmospheric interactions, and health implications <b>Ankush Kaushik</b> , Leibniz Institute for Tropospheric Research (TROPOS)
9:45	Content level of representatives of volatile organic compounds in indoor environment of childcare facilities located in Poland <b>Mariusz Marć</b> , Gdansk University of Technology, Gdańsk, Poland
10:00	Transnational corporation for green transformation on the example of RARR projects <b>Marek Duda</b> , Rzeszów Regional Development Agency, Rzeszów, Poland
10:15	Investigating Microfiber and Microplastic Pollution in Wastewater: A Comparative Analysis of Recovery and Characterization Methods <b>Sinem Hazal Akyildiz</b> , University of Torino, Italy
10:30	Enhanced gas separation in polyamidoamine dendrimers-embedded Perbax membranes: impact on CO <sub>2</sub> /N <sub>2</sub> selectivity and permeability <b>Gabriela Santos Medeiros</b> , Institute of Macromolecular Chemistry, Prague, Czech Republic
10:45	Plastic pollution in shooting ranges and warfare areas – an overlooked environmental issue <b>Andres Rodriguez Seijo</b> , University of Vigo, Spain
11:00	COFFE BREAK
11:30-13:00	Workshop: <span style="float: right;">University of Rzeszów, Pigionia 1, Building A0, B4, lab. 106</span> Sample grinding in microplastic analysis – Freezer/Mill workshop <b>Grzegorz Pluta</b> , Altium International Sp. z o. o., Poland Pyr-GC-MS in microplastic analysis <b>Magdalena Podbielska</b> , University of Rzeszów, Poland <span style="float: right;">(continued after lunch)</span>
13:00	LUNCH
14:00-14:15	Closing ceremony, Poster and Lecture Award

## Joana C. Prata



**Joana C. Prata**, DVM PhD, is an Invited Auxiliary Professor at the IUCS and at the University Institute of Health Sciences, CESPU, Portugal. She has a PhD in Biology and Ecology of Global Changes specialized in Environmental Biology and Health (2021). She conducts interdisciplinary research on contaminants, having published over 50 peer-reviewed papers (h-index of 28) and is a highly cited researcher. She is currently the Editor-in-Chief of Water Emerging Contaminants & Nanoplastics.

She has been involved as a team member in several national projects and is the responsible investigator on a project studying dietary human exposure to microplastics (MICROEXPOS\_GI2-CESPU-2023). She has experience in working with risk assessment, toxicology, analytical methodologies (for chemical characterization of contaminants), and biochemical and molecular tools. She has supervised 2 Bachelor students and is currently supervising 2 PhD students and 2 Master students.

## O1 THE HEALTH IMPACTS OF MICROPLASTICS

Joana C. Prata<sup>1</sup>

<sup>1</sup>Cooperativa de Ensino Superior Politécnico e Universitário-CESPU, Rua Central de Gandra, 1317, 4585-116 Gandra, Portugal

Email address: joanacorreiaprata@gmail.com

Microplastics, plastic particles  $\leq 5$  mm, are pervasive environmental contaminants resulting from the fragmentation of larger plastics (secondary) or production for industrial applications (primary). Exposure to microplastics mainly occurs through oral and respiratory routes. Microplastics contaminate the food chain due to their presence in the tissues of organisms but also due to processing and contact with plastic food contact materials. These particles also integrate particulate matter and can be inhaled. A small percentage (<1%) of the ingested and inhaled particles will be able to cross biological barriers and reach other tissues. The toxicology of microplastics is not fully understood, but it seems to involve physical and chemical effects. Besides leachates from plastics, such as additives, microplastics also carry adsorbed contaminants and microorganisms gathered from the environment. Therefore, each particle is unique in its composition, further complicating toxicity evaluation. Indirect effects may also involve impacts on ecosystems that may compromise food production. The complexity of microplastics' pharmacokinetics and pharmacodynamics, as well as indirect effects on human health, will be discussed in this session.

## Zisis Vryzas



**Dr. Zisis Vryzas** holds BSc and MSc degree in Crop Protection and PhD in Pesticide Science. He teaches undergraduate and post-graduate courses in the fields of Pesticide Science (Introduction to Agricultural Pharmacology, Advanced Agricultural Pharmacology, Agrochemical Fate in the Environment, Integrated Crop Protection -Product Certification) and Environmental Protection (Agriculture and Environment, Ecotoxicology, Ecological Risk Assessment and Agro-ecosystem Pollution).

His research expertise is focused on the:

- Development of pesticide residue and toxins analytical methods
- Environmental fate of pesticides and contamination of surface- and groundwater bodies
- Monitoring of pesticide residues in environmental samples, food and Feed
- Pesticide risk assessment and prioritization exercises
- Ecotoxicological behavior of pesticides and their metabolites
- Effects of post-harvest treatments on the fate of pesticides on processed foods
- Interactions of pesticides with soil microbial community - Plant Growth Promoting Rhizobacteria (PGPR)
- Use of Constructed Wetlands for remediation of pesticide point source pollution sites.

The last six years within the frame of the EU project MSCA-RISE European Commission H2020, KNOWPEC he has focused on prioritization of pesticides and conducting hierarchic risk assessment of pesticides under various environmental and agricultural conditions. Dr. Zisis Vryzas is also a member of the IUPAC Advisory Committee on Crop Protection Chemistry and member of the editorial board of the IUPAC's CropChem News and ACS Agricultural Science & Technology. His research activity has resulted in 50 articles in international peer-reviewed journals (total citations:2600, h-index:28). He has reviewed over 300 papers in more than 40 international scientific journals. He was a member of the organizing and scientific committee of the 14<sup>th</sup> and 15<sup>th</sup> IUPAC International Congress of Crop Protection Chemistry and of the SETAC EUROPE 32<sup>nd</sup> annual meeting.

## **O2 IMPORTANCE OF APPLYING NEW APPROACH METHOD IN PESTICIDE RISK ASSESSMENT**

Zisis Vryzas<sup>1</sup>

<sup>1</sup>Pesticide Science Laboratory, School of Agriculture, Aristotle University of Thessaloniki, 54126 Thessaloniki, Greece

Email address: [zvryzas@agro.auth.gr](mailto:zvryzas@agro.auth.gr)

In response to the European Green Deal, more particularly the Farm to Fork Strategy<sup>2</sup>, the Biodiversity Strategy and the Sustainable Use Directive the Commission, the European Food Safety Authority (EFSA) and the Member States (MS) authorities have introduced measures to reduce the use of chemical plant protection products (PPPs), and to encourage the introduction in the market of low-risk-pesticides and to upgrade their use [1-3].

Pesticide risk assessment is undergoing a transformative evolution through the integration of New Approach Methodologies (NAMs). Traditional assessment strategies have largely depended on animal testing and standardized protocols that may not fully capture the complexities of modern low-risk active substances. The incorporation of NAM (including in silico models, high-throughput screening, omics technologies, advanced in vitro assays, and weight-of-evidence frameworks) enables more rapid, cost-effective, and mechanistically driven evaluations. Key case studies and current research initiatives illustrate how NAMs effectively bridge data gaps, reduce uncertainty, and provide more informative hazard and exposure characterizations. A scientific rationale will be presented for adopting fit-for-purpose approaches tailored to the unique properties and exposure scenarios of synthetic, non-synthetic, and novel active substances. Furthermore, the presentation addresses challenges related to regulatory implementation and underscores the need for harmonized guidance to reliably integrate alternative methods into risk assessment frameworks. Ultimately, this presentation highlights the potential of NAMs to revolutionize pesticide risk assessment, thereby supporting a shift toward safer and more sustainable crop protection strategies while upholding high standards for human and environmental health.

[1] [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en), access: 16 March 2025.

[2] [https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy\\_en](https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en), access: 16 March 2025.

[3] <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0380>, access: 16 March 2025.

## M. Russel



Dr. **M. Russel** received his M.Sc and Ph.D. degree in Environmental Science and Engineering in the year of 2009 and 2012 respectively, from the China University of Geoscience, Wuhan, P R China and B.Sc in Leather Technology in the year of 2004 from University of Dhaka. Dr. Russel received research training as a visiting scholar at the State Key Laboratory of Freshwater Ecology and

Biotechnology, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan, P R China. He had couple of research fellowship experiences during Masters and PhD study periods. Like M. Phil exchange fellowship at the department of chemistry, Hong Kong Baptist University, Doctoral joint research fellowship at Department of Environmental science and engineering, Waikato University and Food and Bio-based Group, Agresearch Ltd. Hamilton, Newzeland. He had worked with DESA, Sustainable development group in United Nation, New York, USA, Head Quarter for sound environmental management.

Dr Russel is currently working as an Associate Professor for Environmental Pollution and Ecological Monitoring at School of Chemical Engineering, Ocean & Life Science, Dalian University of Technology, P. R. China since September, 2013. Dr Russel is an environmental science and engineering expert with more than 14+ years' experience and worked with several local and international organizations as well as research institutes. He served as a scientific reviewer, consultant and associates for ADB, WB and IFC funding projects national and internationally through Easen International Ltd. (Shanghai based consulting firm). Dr. Russel has contributed to the research and development sector with his novel research of developing novel dielectric spectroscopic sensor monitoring the environmental soil and water contamination challenges. He also has developed novel biological approaches to remediate the current water pollution challenges. His novelty and creativity in the research field of environmental science is commensurate with his publication in various sci indexed journals. To date he has published more than 50 sci-indexed international journal and international conference proceedings, 3 patents, and 6 Keynote speech. He has also Chair in couple of international conference. Dr Russel coedited and edited a couple of books and a book chapter which were published in prestigious Elsevier journals. Dr. Russel is currently 3 international journal editorial board member and working as reviewer.

### **O3 GREEN SUSTAINABLE ALGAE-BACTERIA COMBINE APPROACH TO HANDLE THE CURRENT WATER ENVIRONMENTAL EMERGING CONTAMINANTS CHALLENGES**

Mohammad Russel<sup>1</sup>, Veghar Amirian<sup>1</sup>, Wu Lei<sup>1</sup>, Zhang Ming Lu<sup>1</sup>, Xu Dong<sup>1</sup>

<sup>1</sup>School of Chemical engineering, Ocean and Life Sciences, Key Laboratory of Industrial Ecology and Environmental Engineering, Ministry of Education, Dalian University of Technology, Panjin 124221, P.R. China

E-mail address: mrussel@dlut.edu.cn/russellt011@gmail.com

Water pollution, driven by conventional contaminants (organic/inorganic compounds, heavy metals) and emerging contaminants (ECs) like microplastics and pharmaceuticals, threatens ecosystems and human health due to ECs' persistence, bioaccumulation, and resistance to degradation. Current remediation methods (e.g., activated sludge, chemical precipitation) face limitations such as high costs, energy inefficiency, secondary pollution, and inadequate analytical techniques for complex contaminant mixtures. Addressing these challenges necessitates innovative, sustainable, and cost-effective technologies to align with environmental and public health priorities.

Algae-bacteria coculture systems provide a green sustainable, efficient, and cost-effective wastewater treatment alternative by converting pollutants into biomass via bioremediation, minimizing chemical use and secondary pollution. Mutualistic interactions enhance nutrient exchange, enabling resource recovery (e.g., biofuels, metabolites) and CO<sub>2</sub> sequestration. Challenges include optimizing symbiosis mechanisms, species selection, and scalability. The author team optimized *Desmodesmus* sp.-*Achromobacter pulmonis* (1:1) enhanced dibutyl phthalate removal (93%), while a *Klebsiella pneumoniae*-*Desmodesmus* sp. system improved tetracycline removal (95%) via microbial interactions and pH regulation [1-2]. Developed a *Scenedesmus obliquus*-*Acinetobacter pittii* (2:1) system for wastewater treatment, achieving high nutrient removal through daylight gas exchange [3]. This green technology promising for advancing environmental sustainability and addressing global pollution challenges through energy recovery and waste valorization.

[1] Yihe Q. et al. *Bioresour. Technol.*, 2024, 395(12):130372, doi:10.1016/j.biortech.2024.130372.

[2] Xu J. et al. *Bioresour. Technol.*, 2022, 351(1):127056, doi:10.1016/j.biortech.2022.127056.

[3] Russel M. et al. *Bioresour. Technol.*, 2020, 299:122571., doi:10.1016/j.biortech.2019.122571.

## 04 ONE HEALTH PERSPECTIVE ON DIETARY EXPOSURE AND HEALTH IMPLICATION – RARE EARTH ELEMENTS (REE) IN THE ENVIRONMENT

Andrzej R. Reindl<sup>1</sup>, Lidia Wolska<sup>1</sup>

<sup>1</sup> Medical University of Gdansk, Faculty of Health Sciences, Department of Environmental Toxicology, Dębowa 23A Str, 80-204 Gdansk, Poland

Email address: Andrzej.Reindl@gumed.edu.pl

Rare earth elements (REEs) are natural components of the Earth's crust. Their increasing industrial use in refining, metallurgy, and medicine raises concerns about environmental and health risks. This study applies a One Health framework to assess REEs bioaccumulation and exposure through commercially available fish and Baltic grey seals (*Halichoerus grypus*).

Recent studies indicate significant REEs accumulation in Baltic herring (*Clupea harengus membras*) and European sardine (*Sardina pilchardus*), with sardines exhibiting higher muscle concentrations ( $\Sigma\text{REE} = 0.191 \pm 0.163$  mg/kg) than herring ( $\Sigma\text{REE} = 0.076 \pm 0.047$  mg/kg). Elevated REE levels in ova and seminal fluid suggest potential intergenerational transfer [1]. REEs were found in the excrement and fur of Baltic grey seals, including juveniles. Biological material was primarily composed of light REEs (LREEs), while lanugo contained only lanthanum and cerium. The highest concentrations in both feces and fur were light REEs (LREEs: cerium, neodymium, lanthanum). The daily REE load excreted in grey seal feces was estimated at 0.141 mg, with LREEs and heavy REEs (HREEs) comprising 31% and 9%, respectively. Notably, scandium, which does not belong to either group, was predominant in feces but absent in fur. On an annual scale, REEs excreted via fur represented just over 1% of the total REE load released through feces [2]. We also detected REEs in the blood of mother seals and their pups across life stages. The total REEs concentration in lactating mothers was higher than in non-lactating individuals. Pups showed lower REE transfer during lactation compared to those on a fish-based diet, with HREEs playing a dominant role in both mothers and pups. Placental sample analysis revealed significant variability, highlighting differences in environmental exposure and maternal-fetal transfer.

REEs, increasingly used in industry, accumulate in marine food chains and mammalian tissues, posing potential ecological and health risks. Our study highlights their bioaccumulation and intergenerational transfer in Baltic fish and grey seals, emphasizing the need for further investigation into long-term impacts on wildlife and human health.

[1] Reindl A.R., Falkowska L.J. Trace Elem. Med. Biol., 2021, 68:126803, doi:10.1016/j.jtemb.2021.126803.

[2] Reindl A.R. et al. Sci. Tot. Env., 2021, 754:141947, doi:10.1016/j.scitotenv.2020.141947.

## **O5 ASSESSMENT OF CONSUMER EXPOSURE TO SELECTED PESTICIDE RESIDUES IN FRESH FOOD**

Maciej Tankiewicz<sup>1</sup>, Lidia Wolska<sup>1</sup>

<sup>1</sup>Department of Environmental Toxicology, Faculty of Health Sciences with Institute of Maritime and Tropical Medicine, Medical University of Gdańsk, Address: Dębowa Str. 23 A, 80-204 Gdańsk, Poland

Email address: maciej.tankiewicz@gumed.edu.pl

Food safety is one of the top priorities in the field of public health. This applies specially to fresh fruits and vegetables as they are generally consumed directly and predominantly without any processing. They are a good source of vitamins, minerals and fibers, but at the same time they can also be a source of toxic substances, e.g. pesticide residues. Their presence in food may pose a potential health risk to consumers. The aim of the study was to assess whether fruit peel may be one of the routes of pesticide permeation into the pulp, the residue levels of which should be monitored in accordance with applicable legal regulations. Three fungicides (boscalid, captan and cyprodinil) were selected for research. These compounds are regularly detected in apples during monitoring studies carried out by state services. For peel testing, a Franz flow-type vertical diffusion cell system was used.

An attempt was also made to estimate the exposure to pesticide residues detected in apples of different varieties and to assess whether these residues pose a risk to the health of consumers. Based on the obtained data, no long-term risk has been identified for the estimated residues. Only one sample represented a potential long- and short-term risk, in which non-compliance with the maximum residue level for captan was demonstrated. Moreover, a biomonitoring study was also conducted, which is an effective tool for assessing consumer exposure. For this purpose, residues of selected fungicides in blood serum samples were determined. Studies confirm that the peel is ineffective barrier to pesticides and may be one of the ways of their penetration into the apples. Compounds penetrating through the peel into deeper layers of pulp undergo accumulation resulting in contamination of food. Moreover, there is no data on the possible accumulation of pesticide doses in the pulp, which would reflect their size and diffusion kinetics. This would allow a reliable assessment of the peel barrier, and thus the safety of apple consumption. As a result of fungicide contamination, their presence in blood serum samples was also found, which confirms consumer exposure to these compounds.

*This study was funded by the National Science Center in Poland (project No. 2015/19/D/NZ7/03283) and the Ministry of Science and Higher Education in Poland (ST No. 01-30025/0008355/322/2025). The research was approved by the Independent Bioethics Committee for Scientific Research at the Medical University of Gdańsk (NKBBN/374/2017).*

## **06 LESSONS LEARNED FROM REGULATING POLLEN EMISSIONS IN HUNGARY USING THE POTENTIAL ALLERGENICITY INDEX (CARE-S)**

Donát Magyar<sup>1</sup>, Anna Páldy <sup>1</sup>, Tamás Szigeti<sup>1</sup>, László Orlóci<sup>2</sup>

<sup>1</sup>National Center for Public Health and Pharmacy, Budapest, Hungary

<sup>2</sup>Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

Email address: magyar.donat@gmail.com

Plant taxa exhibit varying degrees of allergenicity. Existing systems for categorizing plants based on their allergenicity were reviewed to identify a method suitable for regulating green areas. Such categorization serves multiple purposes, including informing allergic individuals, warning consumers in horticultural markets, and evaluating urban green areas. However, regulating allergenic plants in trade and urban greening is an emerging application of allergenic categorization.

Our review revealed that the existing systems are inadequate for regulatory purposes, as they often lack methodological transparency, affecting reproducibility, and provide insufficient evidence on allergenicity [1]. To address these limitations, a new evidence-based categorization system (CARE-S) was developed, focusing on stable, genetically determined factors: immunogenicity, morphology, and pollen production [1]. This approach determines the potential allergenic effect of plants based on their genetic characteristics, specifically their capacity to produce and release allergenic substances into the air in significant, inhalable quantities. In contrast, unstable, context-dependent factors (e.g. geographical distribution, population size, pollen concentration, length of the pollen season, and the number of allergic individuals) were excluded, as these factors become relevant only after the plant has established large populations. From a preventive perspective, potential allergenicity is the key criterion.

Recently, the CARE-S system categorizes 858 plant taxa, primarily those common in urban areas in the Pannonian Biogeographical Region. It can be applied to other biogeographic regions and new plant varieties by an online calculator tool [2]. As a regulatory adaptation of CARE-S, Government Decree 519/2023 has entered into force to suppress the planting of allergenic trees. A beneficial side effect of this regulation is the catalysis of breeding low-allergenic plant varieties. Additionally, it might provide a legal framework to prevent the introduction of (new) allergenic plants by trade.

[1] Magyar D. et al. UFUG, 2022, 70:127530, doi:10.1016/j.ufug.2022.127530.

[2] Online page: <https://ars.els-cdn.com/content/image/1-s2.0-S1618866722000735-mmc1.xlsx>.

## **07 AEROBIOLOGY – AUTOMATIC REALTIME SAMPLING AND ANALYSIS OF AIRBORNE POLLEN GRAINS AND FUNGAL SPORES**

Branko Šikoparija<sup>1</sup>, SYLVA project team

<sup>1</sup>BioSense Institute Research Institute for Information Technologies in Biosystems, University of Novi Sad, Novi Sad, Serbia

Pollen and fungal spores monitoring has traditionally been carried out using manual Hirst volumetric method [1]. Despite extensive monitoring network in Europe, the data are of little use for assimilation with forecasting models because only being available with a delay of 1–8 days and usually delivered at a daily resolution. Several automatic real-time instruments available in the market were compared to standard measurements under the same environmental conditions as part of the EUMETNET Autopollen and COST ADOPT-intercomparison campaign [2], setting the basis for automatization aerobiological networks. Although the automatic systems, that combine high-end imaging, laser and holographic techniques, and rely on big-data and machine learning for data processing, show high overall accuracy ( $\geq 90\%$ ) for identification pollen and fungal spores in laboratory conditions, the improvement of performance in operational measurements is continuous process, including handling false positives and transferability of algorithms to different devices, locations and seasons. The new methods benefit from precision sampling technology, high-end imaging, laser and holographic techniques, and rely on big-data and machine learning for data processing. Presently, there are only two operational automatic monitoring networks, both in central Europe, with expanding coverage of research sites scattered around the continent. A Horizon Europe project SYLVA [3] has been started in 2023 aiming to: (i) Develop cutting-edge bioaerosol monitoring technologies, (ii) Create bioaerosol monitoring ICT infrastructure and software following open-source principles and connect it to European environmental observing systems, (iii) Validate the operational maturity.

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## O8 MICROPLASTIC POLLUTION IN SURFACE WATERS AND SEDIMENTS OF MULTIPLE LAKES IN TÜRKİYE: PRELIMINARY FINDINGS

Sedat Gündoğdu<sup>1</sup>, Vedat Yeğen<sup>2</sup>, Soner Çetinkaya<sup>3</sup>, Tuncay Vural<sup>2</sup>, Seçil Tüzün Duğan<sup>3</sup>, Murat Yeşiltaş<sup>3</sup>, Hakan Eren<sup>2</sup>, Selman Şapçioğlu<sup>2</sup>, İbrahim Özdağ<sup>2</sup>, İrem Nur Yeşilyut Ergan<sup>1</sup>, Cem Çevik<sup>1</sup>

<sup>1</sup>Çukurova University, Faculty of Fisheries, Department of Basic Science, Adana, Türkiye

<sup>2</sup> Fisheries Research Institute, Eğirdir, Isparta, Türkiye

<sup>3</sup>Mediterranean Fisheries Research, Production and Training Institute, Antalya, Türkiye

Email address: sgundogdu@cu.edu.tr; sedat.gundogdu.65@gmail.com

The presence of microplastics, also known as emerging pollutants, in water, soil, and air has become a significant concern for all ecosystems [1]. In particular, microplastic pollution in marine and freshwater environments is known to have numerous direct and indirect harmful effects [2]. While research on this issue has been increasing worldwide in both freshwater and marine ecosystems, studies focusing on Türkiye's inland waters remain limited. This study investigates the presence of microplastics in the surface waters and sediments of several natural lakes in Türkiye. For this purpose, six lakes of varying sizes and depths, located in the South Aegean and Western Mediterranean regions (Yazır, Beyşehir, Burdur, Karataş, Salda, and Kovada), were examined for microplastic pollution. Water samples were collected using a manta net with a mesh size of 330 microns, while sediment samples were obtained using a Van Veen grab sampler [3].

The microplastic concentration in water samples ranged from 21,598 to 341,976 particles/km<sup>2</sup> across the lakes. The highest mean concentration was observed in Kovada Lake (341,976 particles/km<sup>2</sup>), while the lowest was in Yazır Lake (21,598 particles/km<sup>2</sup>). Overall, the results indicate that microplastic pollution is widespread across the studied lakes, with notable differences between lakes. The highest contamination levels were detected in Kovada and Burdur lakes, while Yazır exhibited the lowest pollution levels.

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## O9 NEW METHOD FOR MICROPLASTIC EXTRACTION AND SAMPLE PREPARATION FOR LDIR ANALYSIS

Wojciech Strojny<sup>1</sup>, Renata Gruca-Rokosz<sup>1</sup>, Maksymilian Cieśla<sup>1</sup>

<sup>1</sup>Department of Chemistry and Environmental Engineering, Faculty of Civil and Environmental Engineering and Architecture, Rzeszów University of Technology, 35-959 Rzeszów, Poland

Email address: w.strojny@prz.edu.pl

Monitoring the quantity of microplastics (MPs) is a key element in assessing environmental pollution. It serves as the basis for political decisions regarding ecosystem protection. Accurate identification and quantification of MPs are essential to determine their impact on soils, water, and living organisms. These analyses are also crucial for developing mitigation strategies [1]. Due to the wide diversity of environmental matrices in which MPs are found, developing universal and effective methods for extraction and sample preparation remains a significant challenge [2].

The sample preparation process for MPs analysis involves several stages, such as chemical digestion, density separation, drying, and suspension filtration. Each stage can result in material loss or sample contamination. There is a notable lack of dedicated laboratory equipment that allows sample preparation without transferring the sample between different laboratory vessels [3].

In response to these challenges, the authors propose a new sample preparation method using patented glass separators. These separators simultaneously function as reaction vessels for chemical processing. The use of a single laboratory vessel throughout all preparation stages minimizes the risk of accidental contamination and maximizes the efficiency of MPs extraction.

The developed method has been adapted to the requirements of the LDIR chemical imaging system. A key aspect of LDIR analysis is obtaining a monolayer of particles on a surface that effectively reflects IR radiation, such as slides or metalized filters. Precise sample preparation is fundamental to ensuring the reliability of the results. The development of new analytical methods contributes to improving the quality of MPs research and their impact on the environment.

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## **O10 FROM WASTEWATER TO SNOW: A WATER PATHWAY OF ANTIMICROBIALS AND THEIR EFFECT ON GRAM-NEGATIVE BACTERIAL RESISTANCE**

Anna Lenart-Boroń<sup>1\*</sup>, Klaudia Stankiewicz<sup>1</sup>, Justyna Pajsnar<sup>2</sup>, Klaudia Bulanda<sup>3</sup>, Natalia Czernecka<sup>4</sup>, Anna Ratajewicz<sup>4</sup>

<sup>1</sup>Department of Microbiology and Biomonitoring, Faculty of Agriculture and Economics, University of Agriculture in Kraków, Adam Mickiewicz Ave. 24/28, 30-059 Kraków, Poland

<sup>2</sup>Jerzy Haber Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences, Kraków, Poland

<sup>3</sup>Department of Forest Ecosystems Protection, Faculty of Forestry, University of Agriculture in Kraków, 29 Listopada Ave. 46, 31-425 Kraków, Poland

<sup>4</sup>Scientific Circle of Biotechnologists, Faculty of Biotechnology and Horticulture, University of Agriculture in Kraków, 29 Listopada Ave. 54, 31-425 Kraków, Poland

Email address: natalia.czernecka2@student.urk.edu.pl,  
anna.ratajewicz@student.urk.edu.pl

In recent years, increasing presence of antimicrobial agents in the aquatic environment has become the subject of intensive research, especially in the context of their impact on the development of bacterial resistance. Despite growing public awareness, the problem of drug resistance among bacteria continues to spread, which causes more and more antibiotics become ineffective which then makes infection treatment more complicated.

Surface water samples collected from the vicinity of the frequently visited ski resort in southern Poland were analyzed. River water is transferred to reservoirs and collected until technical snowmaking. Isolation and identification of *Escherichia coli*, *Salmonella*, *Shigella*, *Enterococcus faecalis*/*E. faecium* and other potential human pathogens were isolated and enumerated on chromogenic media. Pure strains were isolated and identified by MALDI-TOF mass spectrometry. The isolated strains were classified according to systematic affiliation and their antibiotic resistance was assessed following the recommendations of EUCAST [1]. The presence of antibacterials in water was determined by solid phase extraction followed by high-performance liquid chromatography tandem mass spectrometry.

Bacteria of 6 families were identified: *Enterobacteriaceae*, *Pseudomonadaceae*, *Moraxellaceae*, *Aeromonadaceae*, *Bacillaceae*. The obtained results indicate a relatively high susceptibility of the tested strains to the antibiotics used in the experiment (however, several strains exhibited the extended-spectrum  $\beta$ -lactamase mechanism). This fact is extremely promising, as no significant resistance to the used chemotherapeutics was noted. However, the presence of antibiotics in the aquatic

environment is worrying. As many as 11 antibiotics were detected, i.e.: vancomycin, cefoxitin, erythromycin, tylosin, trimethoprim, ofloxacin, ciprofloxacin, enrofloxacin, clindamycin, sulfamethoxazole and linezolid.

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## O11 RECENT INSIGHTS INTO PARTICULATE MATTER.

### CYTOTOXICITY ASSESSMENT OF AIR POLLUTION PARTICLES IN PODKARPACKIE REGION

Małgorzata Kus-Liśkiewicz<sup>1</sup>, Aleksandra Sikorowicz<sup>1</sup>, Bartosz Jagusztyn<sup>1</sup>, Dariusz Płoch<sup>2</sup>, Anna Pomykała<sup>3</sup>, Paulina Książek-Trela<sup>1</sup>

<sup>1</sup>Faculty of Biotechnology, Collegium Medicum, University of Rzeszow, Pigonia 1, 35-310 Rzeszow, Poland;

<sup>2</sup>Institute of Materials Engineering, Faculty of Exact and Technical Sciences, University of Rzeszow, Pigonia 1, 35-310 Rzeszow, Poland

<sup>3</sup>Chief Inspectorate for Environmental Protection, Langiewicza 26, 35-101 Rzeszow, Poland

Email address: mkus@ur.edu.pl

The ambient air quality pollutants can impact human health, ecosystems and vegetation and therefore, monitoring is carried out to determine their concentration levels. Indeed, the air pollution is described as a source of increasing morbidity and premature mortality [1,2]. World Health Organization (WHO) has been reported in 2016 that around 8 million people die every year from exposure to polluted air [3]. Particulate matter (PM) is believed as the one of the main air pollutants, and its concentration is well monitored in many countries, displaying the real-time daily concentration level of PM<sub>2.5</sub> and PM<sub>10</sub>. Because of constantly exposure to the air pollution, the particulate matter enters the human body via inhalation, ingestion and deposition on the skin. Therefore, it is important to analyze their toxic effect, as PM mass concentration alone is not sufficient to understand the biological response to particle matter exposure [4].

The objective of this study was to describe the PM<sub>2.5</sub> and PM<sub>10</sub> toxic mechanism of action collected in five different cities in Podkarpackie region. The places for sampling were chosen based on the type of the characteristic of the city, i.e. urbanized, industrial or health resort. The cytotoxic effect and impact on the cell migration ability of water-soluble and organic fraction of PM<sub>2.5</sub> or PM<sub>10</sub> was evaluated as well as the inhibitory potential of the PM extracts on the human microbiome. The mass concentration distribution characteristics of extracted particulate matter was revealed. The morphology and component analysis of the obtained PM were performed through scanning electron microscopy (SEM–EDX).

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## **O12 AIRBORNE NANO- AND MICROPLASTICS AS EMERGING ENVIRONMENTAL CONTAMINANTS: DISTRIBUTION, ATMOSPHERIC INTERACTIONS, AND HEALTH IMPLICATIONS**

Ankush Kaushik<sup>1</sup>, Anju Elizabeth Peter<sup>1</sup>, Manuela van Pinxteren<sup>1</sup>, Barbara M. Scholz-Böttcher<sup>2</sup>, Hartmut Herrmann<sup>1</sup>

<sup>1</sup>Atmospheric Chemistry Department (ACD), Leibniz Institute for Tropospheric Research (TROPOS), Permoserstraße 15, Leipzig, 04318, Germany

<sup>2</sup>Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky University of Oldenburg, P.O. Box 2503, D-26111 Oldenburg, Germany

Email address: [kaushik@tropos.de](mailto:kaushik@tropos.de)

Airborne nano- and microplastics (NMPs) have emerged as significant environmental contaminants, raising growing concerns about their atmospheric behaviour, environmental fate, and potential health implications. This study investigates the distribution, polymeric composition, and interactions of airborne NMPs with carbonaceous species in an urban environment. Particulate matter (PM) samples were collected over two weeks and analysed to determine the presence of synthetic polymers across different size fractions, including PM<sub>10</sub>, PM<sub>2.5</sub> (fine microplastics, FMPs), and PM<sub>10-2.5</sub> (coarse microplastics, CMPs). The results revealed an average NMP concentration of  $0.6 \pm 0.2 \mu\text{g}/\text{m}^3$  in PM<sub>10</sub>, with nearly equal contributions from FMPs and CMPs. Tire wear particles were the predominant NMP type (~65%), with car tire tread accounting for the largest fraction (56–60%). Polymer-specific analysis indicated that PVC, PC, PMMA, and TTT were more prevalent in FMPs, while PP, PE, PET, and PS were dominant in CMPs. Strong correlations among specific FMPs suggest common emission sources and atmospheric transformation processes. In contrast, CMPs showed weaker correlations, likely due to their higher deposition rates and more diverse sources. Significant interactions between NMPs and carbonaceous species were observed, particularly in FMPs, indicating shared atmospheric processes such as adsorption and secondary formation mechanisms. A health exposure assessment estimated a daily inhalation intake of  $2.1 \mu\text{g}/\text{day}$  for PM<sub>10</sub> NMPs, with  $1.1 \mu\text{g}/\text{day}$  from FMPs and  $0.9 \mu\text{g}/\text{day}$  from CMPs. Probability density function analysis indicated that FMPs have a higher exposure probability, increasing their likelihood of inhalation and deep respiratory deposition, which may contribute to inflammation and oxidative stress. This study highlights airborne microplastics' distribution, interactions, and health risks, emphasizing the need for interdisciplinary efforts to assess exposure and mitigation.

## **O13 CONTENT LEVEL OF REPRESENTATIVES OF VOLATILE ORGANIC COMPOUNDS IN INDOOR ENVIRONMENT OF CHILDCARE FACILITIES LOCATED IN POLAND**

Mariusz Marc<sup>1,2</sup>, Natalia Jatkowska<sup>1</sup>, Małgorzata Rutkowska<sup>1</sup>, Bożena Zabiegała<sup>1</sup>

<sup>1</sup>Department of Analytical Chemistry, Faculty of Chemistry, Gdańsk University of Technology, G. Narutowicza 11/12 Street, Gdańsk, Poland

<sup>2</sup>Departamento de Medio Ambiente, INIA, Carretera de A Coruña km 7, 28040, Madrid, Spain

Email address: marmarc@pg.edu.pl

The importance of indoor air quality (IAQ) rapidly increased since last decade, which was initiated by the fact that people spend up to 90% of their time in different types of indoor environment [1]. In the literature might be found studies showing the associations between respiratory health and IAQ indicate the importance of regional and personal factors such as age, gender and existence of related diseases. One of the main parameters that should be monitored in different types of indoor facilities is the type and amount of volatile organic compounds (VOCs). It was found that VOCs are related to asthma and asthma related symptoms [2]. From all of VOCs, benzene, toluene, ethylbenzene, and xylenes (BTEX) are most often monitored, because of their toxicity, their ubiquity in indoor air and their easiness to monitor [3,4]. However, guideline values for indoor air quality exist only for a few countries or regions such as Germany, Norway, Flanders (Belgium), China and Canada [5]. The issue of indoor air pollution takes in a special meaning when considering specific types of environments, which should provide the best possible long-term residence conditions, such as childcare facilities. For this reason, indoor air pollution of childcare facilities is not only an important social issue but also a global public health care problem. The purpose of the study was to monitor indoor air quality in the enclosed areas of childcare facilities located in several places in Poland. During performed investigations, the concentration of representatives of VOCs which occurs in the investigated indoor environments was measured. Additionally, the values of TVOC (total volatile organic compounds) parameter were assessed.

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## **O14 INVESTIGATING MICROFIBER AND MICROPLASTIC POLLUTION IN WASTEWATER: A COMPARATIVE ANALYSIS OF RECOVERY AND CHARACTERIZATION METHODS**

Sinem Hazal Akyıldız<sup>1</sup>, Valentina Balestra<sup>1</sup>, Lia Drudi<sup>1</sup>, Paola Marini<sup>1</sup> and Rossana Bellopede<sup>1</sup>

<sup>1</sup>Department of Engineering for Environment, Land and Infrastructures, Politecnico di Torino, 10129 Torino, Italy

Email address: sinem.akyildiz@polito.it

Microplastic pollution, including microfibers (MFs), has emerged as a significant environmental issue, with wastewater serving as a major pathway for their release into aquatic ecosystems. MFs, which are shed from synthetic and natural textiles, pose a dual threat to the environment and human health due to their persistence, bioaccumulation potential, and ability to act as vectors for harmful chemicals. The textile industry is a notable contributor to this problem, making the monitoring and management of microplastic pollution in wastewater essential. This study investigates the occurrence and analysis of MFs and microplastics (MPs) at various stages of wastewater treatment in a textile dyeing facility. Samples were collected from four stages—underground water, inflow, outflow, and sludge—and subjected to different pretreatment methods, including no pretreatment, quick oxidative treatment, and prolonged oxidative treatment. Filtration techniques were optimized using stainless steel, aluminum oxide, and cellulose acetate nitrate filters. The focus was on evaluating the effectiveness of different methodologies for recovering and characterizing these MFs and MPs while removing organic matter. Key considerations included the efficiency of MFs and MPs recovery, the reliability of the techniques used, and their ability to provide accurate chemical characterization. By comparing approaches, this research offers valuable insights into the presence and behavior of MFs and MPs throughout wastewater treatment processes. The findings highlight the challenges of quantifying microplastic pollution and emphasize the importance of selecting effective analysis methodologies. This work contributes to the development of better strategies for monitoring and mitigating microfiber pollution in wastewater.

## O15 ENHANCED GAS SEPARATION IN POLYAMIDOAMINE DENDRIMERS-EMBEDDED PERBAX MEMBRANES: IMPACT ON CO<sub>2</sub>/N<sub>2</sub> SELECTIVITY AND PERMEABILITY

Gabriela Santos Medeiros<sup>1,2</sup>, Hynek Beneš<sup>1</sup>, Manisha Singh<sup>1</sup>, Rafał Konefał<sup>1</sup>, Olga Kočková<sup>1</sup>, Nadiia Velychkivska<sup>1</sup>, Jiří Hodan<sup>1</sup>, Zbyněk Pientka<sup>1</sup>, Rafał Poreba<sup>1</sup>

<sup>1</sup>Institute of Macromolecular Chemistry, Czech Academy of Science, Heyrovského nám. 2, 162 00 Prague 6, Czech Republic;

<sup>2</sup>Faculty of Science, Charles University, 128 43, Prague, Czech Republic;

Email address: poreba@imc.cas.cz

The utilization of polymeric membranes in carbon capture and gas separation has gained increasing attention due to their low energy consumption and high cost-effectiveness. However, a key challenge of balancing membrane permeability and selectivity still remains. This study investigates the enhancement of gas separation performance, specifically CO<sub>2</sub>/N<sub>2</sub> selectivity and permeability, through the incorporation of first (G1) and second (G2) generation poly(amidoamine) (PAMAM) dendrimers into benchmark poly(ether-*b*-amide) (Pebax) membranes. Membranes were fabricated with varying dendrimer contents (5–15 wt%) via solution casting method. The presence of terminal amine groups in PAMAM dendrimers facilitates CO<sub>2</sub> transport via reversible chemisorption, while the dendritic structure enhances surface area for gas interaction. Fourier-transform infrared spectroscopy (FTIR) and differential scanning calorimetry (DSC) revealed that PAMAM forms hydrogen bonds preferentially with Pebax's 'soft' poly(ethylene oxide) (PEO) domains, leading to an increase in crystallinity and affecting thermal and mechanical properties. Importantly, gas permeability experiments showed that G1 dendrimer-modified membranes, especially at 10 wt%, exhibited a 16 % improvement in CO<sub>2</sub> permeability and an 18 % increase in CO<sub>2</sub>/N<sub>2</sub> selectivity. The G2-modified membranes demonstrated even higher CO<sub>2</sub> solubility, although the compact structure of G2 slightly limited gas diffusion. These results highlight the potential of PAMAM-modified Pebax membranes for enhanced CO<sub>2</sub> capture, providing insights into the impact of dendrimer generation on gas separation (G1 vs G2) performance.

## **O16 PLASTIC POLLUTION IN SHOOTING RANGES AND WARFARE AREAS - AN OVERLOOKED ENVIRONMENTAL ISSUE**

Vanesa Lalín-Pousa<sup>1,2</sup>, Paula Pérez-Rodríguez<sup>1,2</sup>, Claudia Campillo-Cora<sup>1,2,3</sup>, Paulo Pereira<sup>3</sup>, Andrés Rodríguez-Seijo<sup>1,2,3</sup>

<sup>1</sup>Departamento de Bioloxía Vexetal e Ciencias do Solo, Área de Edafoloxía e Química Agrícola. Facultade de Ciencias de Ourense, Universidade de Vigo, As Lagoas s/n, Ourense 32004, Spain

<sup>2</sup>Instituto de Agroecoloxía e Alimentación (IAA). Universidade de Vigo – Campus Auga, Ourense 32004; Spain

<sup>3</sup>Environmental Management Laboratory, Mykolas Romeris University, Vilnius, Lithuania

Email address: andresrodriguezseijo@uvigo.gal

Shooting ranges and military training fields, including warfare-impacted areas, have been widely recognized as environmentally impacted zones by inorganic and organic contamination, such as heavy metals, polycyclic aromatic hydrocarbons or explosive-related compounds. However, the possible contamination by microplastics in soil has been widely overlooked despite potential plastic sources, such as shotgun cartridges, plastic wads or landmines. Due to how these activities occur, plastics have remained in the field for decades or centuries, favoring their conversion from macro to microplastics, polluting the soil and water resources. Moreover, shooting and recreational activities such as airsoft or paintball practices could also be a substantial source of plastics to ecosystems; once shot, pellets can have conventional or biodegradable plastics in their composition, and there left in the environment, favouring impacts on soil properties. Although some initiatives have emerged to avoid the use of single-use plastics in shotgun ammunition, bioplastics can also be a potential risk, favouring the heavy metal bioavailability of shot pellets. These emerging pollutants should also be considered in these areas to understand if they could be a potential source of micro- and nanoplastics to the environment and, therefore, an environmental concern that requires changes at industrial and regulatory levels.

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## O17 PYR-GC/MS IN MICROPLASTIC ANALYSIS

Magdalena Podbielska<sup>1</sup>, Ewa Szpyrka<sup>1</sup>

<sup>1</sup>Faculty of Biotechnology, Collegium Medicum, University of Rzeszów, ul. Pigońia 1, 35-310 Rzeszów, Poland

Email address: mpodbielska@ur.edu.pl

Nowadays, micro- and nanoplastic are environmental contaminants, omnipresent in various ecosystems. There is a lot of instrumental techniques of micro- and nanoplastics analysis but there is an urgent need to develop methods that allow to analysis increasingly smaller particles. In recent decade, several analytical techniques have been used for the analysis of microplastics in environmental samples. The techniques included Fourier transform infrared spectroscopy, Raman spectroscopy, laser diffraction, scanning electron microscope, thermal analysis, and instrumental techniques.

Spectroscopic methods are among the most common approaches, allowing to get information on particle number, size, and polymer identification [1]. Complementary to these techniques, the use of thermal methods gives information on mass concentrations. Instrumental technique which includes pyrolysis coupled with gas chromatography-mass spectrometry (Pyr-GC/MS) allows both the identification and quantification of microplastics in complex environmental matrices. Pyr-GC/MS is used to characterize a wide variety of polymers and composite materials that cannot be analyzed using traditional GC-MS. In this technique it is capable of analyzing macromolecules by gas chromatography breaking them into volatile fragments [2]. Moreover, it is a destructive technique based on the thermal decomposition of polymers, which are then identified by the molecular profile of the generated degradation products [3].

The fundamentals of the Pyr-GC/MS technique and its application in the analysis of micro and nano-plastics will be demonstrated at the presentation. Moreover, we also highlighted advantages, disadvantages, and limitations in analysis.

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## **P1 CYTOLOGICAL AND BIOCHEMICAL RESPONSES OF *CHLORELLA VULGARIS* TO CEFTAZIDIME ANTIBIOTIC AS AN EMERGING POLLUTANT**

Veghar Amirian<sup>1</sup>, Morteza Kosari-Nasab<sup>1</sup>, Ali Movafeghi<sup>1</sup>

<sup>1</sup>Department of Plant, Cell and Molecular Biology, Faculty of Natural Sciences, University of Tabriz, 29 Bahman Blvd, 51666-14779 Tabriz, Iran

Email address: movafeghi@tabrizu.ac.ir

The global proliferation of antibiotics to treat human and veterinary infections has escalated environmental contamination. Among these, ceftazidime (CAZ) is one of particular concern due to its bioaccumulation potential. Sustainable remediation strategies like microalgae, owing to their resilience in controlled systems and cost-effective cultivation, are viable candidates for wastewater treatment. Consequently, this study aimed to assess the efficacy of *Chlorella vulgaris* in remediating CAZ at toxic concentrations ranging from 100 to 500 mg/L. The findings revealed a negative correlation between CAZ concentration and algal growth, with cytotoxicity inducing a marked reduction in cellular density. Morphological analysis via scanning electron microscopy (SEM) demonstrated that exposure to 100 and 200 mg/L elicited surface irregularities, while higher concentrations (300-500 mg/L) caused structural disintegration of the plasma membrane, accompanied by cellular shrinkage and aggregation. Flow cytometric quantification corroborated these results, indicating a decline in cell viability of 70.98%, 65.95%, 61.15%, 58.45%, and 56.19% at CAZ concentrations of 100, 200, 300, 400, and 500 mg/L, respectively. Despite this, *C. vulgaris* exhibited considerable resilience through the upregulation of both non-enzymatic antioxidants (phenolic and flavonoid compounds) and enzymatic defenses (catalase, ascorbate peroxidase, peroxidase, and superoxide dismutase). This adaptive response not only mitigated CAZ-induced cytotoxic stress but also facilitated biodegradation of over 59% of the antibiotic at 100 mg/L. Collectively, these results posited *C. vulgaris* as a promising eco-friendly remediation strategy for mitigating CAZ contamination in aquatic ecosystems.

## P2 DETECTION OF ANTIMICROBIAL RESISTANCE GENES IN THE WATER ROUTE DURING THE TECHNICAL SNOW PRODUCTION PROCESS

Klaudia Bulanda<sup>1</sup>, Klaudia Stankiewicz<sup>2</sup>, Natalia Czernecka<sup>3</sup>, Anna Ratajewicz<sup>3</sup>, Anna Lenart-Boroń<sup>2</sup>

<sup>1</sup>Department of Forest Ecosystems Protection, Faculty of Forestry, University of Agriculture in Kraków, 29 Listopada Ave. 46, 31-425 Kraków, Poland

<sup>2</sup>Department of Microbiology and Biomonitoring, Faculty of Agriculture and Economics, University of Agriculture in Kraków, Adam Mickiewicz Ave. 24/28, 30-059 Kraków, Poland

<sup>3</sup>Scientific Circle of Biotechnologists, Faculty of Biotechnology and Horticulture, University of Agriculture in Kraków, 29 Listopada Ave. 54, 31-425 Kraków, Poland

Email address: [klaudia.bulanda@student.urk.edu.pl](mailto:klaudia.bulanda@student.urk.edu.pl)

Many European wastewater treatment plants cannot fully remove micropollutants such as antibiotics, antibiotic resistant bacteria (ARB), and antibiotic resistance genes (ARGs), leading to their spread into aquatic environments and beyond. The reduction in natural snowfall caused by climate change has made artificial snow production essential in many moderate-climate regions, even though it is a water-intensive process often viewed as environmentally harmful. The resource water used for technical snowmaking often contains these contaminants, which may affect soil, water, and microbial communities through meltwater runoff. This study investigates the presence of antimicrobial resistance genes in the water pathway during the technical snow production process.

Water and snow samples were collected in the area of the Białka River and its selected tributaries, including Remiaszów Potok and Bryjów Potok, during the winter season of 2023/2024 and the summer of 2024. Sampling sites included river water intakes, retention reservoirs (both water and sediment after emptying), artificial snow produced by snow cannons, and sediment from their filters. Using the PCR technique, the collected samples were tested for the presence of 36 genes encoding various bacterial resistance mechanisms to antibiotics. The tested gene classes included: extended-spectrum beta-lactamase determinants (*bla*TEM, *bla*NDM, *bla*VIM, *bla*OXA-48, *bla*OXA-1, *bla*PSE, *bla*CTX-M, *bla*CTX-M9, *bla*CTX-M1, *bla*SHV); genes encoding resistance to macrolides-lincosamides-streptogramin B (*ereB*, *ermA*, *ermB*, *ermC*, *mphA*, *mphC*, *msrA*, *msrB*, *vatA*, *vga*, *vgb*); the methicillin-resistance determinant *mecA*; and others such as *aac6*, *AmpC*, *dfrA12*, *qnrA*, *qnrBm*, *qnrS*, *qnrD*, *strA*, *sull*, *sulll*, *tetK*, *tetL*, and *vanA*. The largest number of ARGs was detected in samples collected at the wastewater treatment plant, with the number of detected genes decreasing at subsequent stages of technical snow production. The most common

ARGs identified were *sull*, *ermB*, and *strA*; however, it is concerning that over 50% of all tested genes were detected.

The increasing reliance on technical snow raises concerns about its environmental and health impacts, necessitating research into issues like microbiological contamination during the technical snow production process and the content of antibiotics and antibiotic resistance genes in water used for this process.

### **P3 RADON EXPOSURE IN THE WORKPLACE**

Agnieszka Dołhańczuk-Śródka<sup>1</sup>, Daniel Janecki<sup>1</sup>

<sup>1</sup>Institute of Environmental Engineering and Biotechnology, University of Opole, ul. Kominka 6, 45-035 Opole, Poland

Email address: agna@uni.opole.pl

Radon is an odorless and colorless radioactive gas that occurs naturally in the environment as a decay product of radium. During this process, radon emits ionizing radiation, primarily in the form of alpha particles. It enters the atmosphere—and consequently also the interiors of buildings—mainly from the ground. If its concentration exceeds safe levels, radon can pose serious health risks, including an increased risk of lung cancer due to prolonged exposure. In Poland, the applicable regulations establish a reference level for the average annual radioactive concentration of radon in the air in workplaces and indoor spaces intended for human occupancy, set at 300 Bq/m<sup>3</sup> [1]. Additionally, legal provisions identify specific areas in Poland where the average annual radon concentration inside buildings is likely to exceed this reference level. These areas are located in five provinces (14 counties in the Lower Silesian province, 1 county in the Lublin province, 2 counties in the Opole province, 6 counties in the Podkarpackie province and 3 counties in the Świętokrzyskie province) [2]. The regulations define these areas based on county boundaries explicitly specified in the legal acts.

Employers operating in the designated radon-affected areas are required to monitor radon levels or the concentration of the potential alpha energy of its short-lived decay products in workplaces. The obligation applies specifically to workplaces:

- Located indoors at ground level or in basements, in areas where a significant number of buildings may have radon concentrations exceeding the reference level.
- Involving groundwater treatment, as such processes can release radon into the air.

Moreover, regardless of location, the employer must ensure radon measurements for any work conducted underground.

[1] Act of 29 November 2000 – Atomic Law.

[2] Regulation of the Minister of Health of 18 June 2020 on areas where the annual average radioactive concentration of radon in indoor air in a significant number of buildings may exceed the reference level.

## **P4 ASSESSMENT OF ELEMENTAL CONTENT IN SOILS OF URBAN GREEN SPACES AS AN INDICATOR OF THE IMPACT OF URBANIZATION ON ENVIRONMENTAL POLLUTION**

Anna Górk<sup>1</sup>, Maria Sanecka<sup>2</sup>, Paulina Babiarz<sup>2</sup>, Agata Fąfara<sup>2</sup>

<sup>1</sup>Department of Biotechnology, Collegium Medicum, University of Rzeszow, Pigoia 1, 35-310 Rzeszow, Poland.

<sup>2</sup>Student Scientific Club „BIO-TECH”, Department of Biotechnology, Collegium Medicum, University of Rzeszow, Pigoia 1, 35-310 Rzeszow, Poland

Email address: agorka@ur.edu.pl

Terrestrial and aquatic ecosystems are exposed to contamination by harmful compounds, including heavy metals. Natural sources of pollution include volcanoes, soil erosion processes and the breakdown of rocks. However, anthropogenic activities contribute more significantly to environmental pollution than natural sources. Human activities include mining and metallurgy, industrial waste, agricultural chemicals, factories, military operations, vehicle emissions, urban sewage, etc. [1]. The progressive process of urbanization and industrialization is increasing pollution in the environment. As a result, the occurrence of harmful metals in the soil is observed, among which are Pb, Cd, Cr, Cu, Zn and Ni. The presence of certain pollutants, including toxic organic and inorganic particles, as well as heavy metals in the environment is a cause for concern and can pose a serious threat to public health. In addition, these compounds can have ecotoxicological effects on terrestrial and aquatic ecosystems. It is worth noting that soil is an important part of the terrestrial ecosystem and the ultimate accumulation site for heavy metals, making it an environment for their spread to water bodies, organisms and the atmosphere [2]. Toxic compounds pose a significant risk to organisms only when their concentrations exceed a specific threshold in the soil. However, some metals (such as Cd or Pb), even in trace amounts, have harmful effects on organisms. Accumulation of heavy metals in the human body contributes to physiological dysfunction and ultimately causes carcinogenesis, mutagenesis and teratogenesis. Therefore, a key aspect is to monitor the status of soil contamination with harmful compounds. For this purpose, instrumental techniques that include atomic absorption spectrometry (AAS) has been used in this study [3].

[1] Kanwar V.S. et al. Environ Sci Pollut Res Int., 2020, 27(36):44835-44860, doi:10.1007/s11356-020-10713-3.

[2] Ahmad W. et al. Sci Rep., 2021, 11(1):17006, doi:10.1038/s41598-021-94616-4.

[3] Li Y. et al. Sci Rep., 2022, 12(1):3855. doi:10.1038/s41598-022-07864-3.

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## **P5 TRANSFORMATION OF HUMIC SUBSTANCES DURING THE BIOLOGICAL STABILISATION OF BIO-WASTE**

Łukasz Jurczyk<sup>1</sup>, Justyna Koc-Jurczyk<sup>1</sup>, Agnieszka Podolak<sup>1</sup>, Natalia Bendas<sup>1</sup>

<sup>1</sup>University of Rzeszów, Faculty of Technology and Natural Sciences, Institute of Agricultural Sciences, Land Management and Environmental Protection, Ćwiklińskiej 1a St., 35-601 Rzeszów, Poland

Email address: [ljurczyk@ur.edu.pl](mailto:ljurczyk@ur.edu.pl)

Biodegradable waste is a special group in the municipal waste stream. So-called bio-fraction contains valuable components that can be returned to the natural cycle and used by vegetation. This paper aimed to analyse the transformation of humic substances during the biological stabilisation of bio-waste. It was assumed that the humification of organic matter was influenced by the degree of fragmentation of the structural material [1, 2]. The experimental layout consisted of two bioreactors operating on a semi-technical scale, with willow branches cut into 15-20 cm pieces (RI) and chips of 0.5 cm (RII). Respiratory activity (AT<sub>4</sub>), humidity, loss on ignition (LOI) and humic acid content (based on absorption coefficients: A<sub>2/4</sub>, A<sub>2/6</sub>, A<sub>4/6</sub>) were analysed in the material regularly sampled from the bioreactors. The results showed that the AT<sub>4</sub> decreased during the stabilisation process, but bio-waste in RII initially showed a higher value compared to RI, which indicates wood chipping enhanced the activity of the microorganisms. A consistent humidity decrease was observed in the FI bioreactor, suggesting that water evaporated evenly during the stabilisation process. The LOI decreased significantly, regardless of the structural material used, indicating an advanced humification process.

It was found that with longer pieces of wood as structural material (RI), bio-waste continuously degraded lignin and converted it into humic substances. All the analysed absorption coefficients revealed that the process of bio-waste stabilisation in RI was more consistent and stable, while in RII, especially at the beginning, was characterized by rapid changes; showing that pre-treatment of structural material can influence the microbial dynamics. Commonly in nature, humic substances have properties that make them desirable components, improving soil quality, reducing various environmental problems in sustainable agriculture, and potentially lowering the costs of soil improvements, as can be recovered from bio-waste and other organic materials.

[1] Tognetti C. et al. *Bioresour. Technol.*, 2007, 98(5):1067-1076.

[2] Tognetti C. et al. *Waste Management*, 2011, 31(6),1146-1152.

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## **P6 EMISSION OF PHTHALIC ACID ESTERS INTO THE AQUATIC ENVIRONMENT FROM SEWAGE SYSTEM COMPONENTS**

Małgorzata Kida<sup>1</sup>, Sabina Ziembowicz<sup>1</sup>, Kamil Pochwat<sup>2</sup>, Piotr Koszelnik<sup>1</sup>

<sup>1</sup>Department of Chemistry and Environmental Engineering, Faculty of Civil and Environmental Engineering and Architecture, Rzeszów University of Technology, 35-959 Rzeszów, Powstańców Warszawy Avenue 6, Poland

<sup>2</sup>Department of Infrastructure and Water Management, Faculty of Civil and Environmental Engineering and Architecture, Rzeszów University of Technology, 35-959 Rzeszów, Powstańców Warszawy Avenue 6, Poland

Email address: mkida@prz.edu.pl

The processes of aging and degradation of microplastics (MPs) in inland waters can lead to the emission of toxic substances that are components of plastics, such as plasticizers, stabilizers, pigments, and flame retardants. It is estimated that over 16,000 different substances may be used in plastic production, of which only 6% are subject to international regulations. These substances can contaminate the aquatic environment and accumulate in living organisms. Microplastics can enter the aquatic environment in various ways, including through the sewage system, for example, due to deteriorating networks and the release of fibers into water bodies. This study presents research on the potential emission of plasticizers into the aquatic environment from MPs originating from sewage system installations. To determine the parameters that had the greatest impact on the emission levels of the analyzed pollutants from microplastics, an environmental model sensitivity analysis was conducted, based on the Hellwig information capacity index. The conducted research confirmed that, depending on environmental conditions, esters of phthalic acid are leached to varying degrees from both PVC sewer pipes and seals. The highest concentrations leached from the sewer pipe were recorded at levels of 0.015 mg/kg, 0.25 mg/kg, and 0.027 mg/kg for DEP, DBP, and DEHP, respectively. In contrast, the seal emitted four plasticizers, namely DMP at 0.06 mg/kg, DEP at 0.05 mg/kg, DBP at 0.37 mg/kg, and DEHP at 0.07 mg/kg. The higher analyzed reaction medium temperatures increased the migration of plasticizers from the microplastics.

## P7 THE ROLE OF EFFECTIVE MICROORGANISMS IN COMMERCIAL FORMULATIONS ON THE DEGRADATION OF A 13-PAH MIXTURE

Paulina Książek-Trela<sup>1</sup>, Damian Figura<sup>2</sup>, Ewa Szpyrka<sup>1</sup>

<sup>1</sup>Faculty of Biotechnology, Collegium Medicum, University of Rzeszów, 1 Pigonia St., 35-310 Rzeszow, Poland

<sup>2</sup>Graduate of the Faculty of Biotechnology, University of Rzeszów, Poland

Email address: pksiazek@ur.edu.pl

Polycyclic aromatic hydrocarbons (PAHs) are frequently present in the soil environment in various forms, including contaminants from industrial activities, vehicle emissions, and the incomplete combustion of organic materials such as coal, oil, and wood. These compounds can accumulate in the soil due to atmospheric deposition, wastewater discharge, and spills, often persisting for extended periods due to their hydrophobic nature and resistance to degradation [1]. PAHs are classified as persistent environmental pollutants, and they often occur as a mixture [2].

The impact of effective microorganisms (EM) and their consortia, present in six commercial formulations, on the degradation of a mixture of 13 PAHs was studied. These formulations, designed for soil revitalization, contain a diverse range of bacterial and yeast species.

Thirty-five days after the application of biological preparations, PAH concentrations decreased by 75.5% to 95.5% from their initial levels. The highest degradation efficiency was observed for fluorene, using a preparation containing eight bacterial strains from the *Bacillus* genus. All tested preparations containing bacterial consortia, as well as the formulation with the yeast *Saccharomyces cerevisiae*, enhanced PAH degradation more effectively than those containing only *Yarrowia lipolytica* or a mixture of *Debaryomyces hansenii* and *Bacillus*. The findings of this study contribute to the advancement of biotechnological methods, specifically microbiological bioremediation, which is safe for both human health and the environment [3].

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## **P8 EVALUATION OF RADIONUCLIDE ACTIVITY IN SOILS FROM VARIOUS FORMS OF LANDUSE: A CASE STUDY IN A SOUTH-EASTERN POLAND**

Patrycja Domaradzka<sup>1</sup>, Stanisław Ryzner<sup>2</sup>, Izabela Piotrowska<sup>2</sup>, Rafał Hakalla<sup>2</sup>, Iwona Makuch-Pietraś<sup>1</sup>

<sup>1</sup>Department of Nature Conservation and Landscape Ecology, University of Rzeszów, 4 Zelwerowicza Street, 35-601 Rzeszów, Poland

<sup>2</sup>Materials Spectroscopy Laboratory, University of Rzeszów, 1 Pigoń Street, 35-310 Rzeszów, Poland

Email address: imakuch@ur.edu.pl

The Carpathian flysch areas and other geological formations of southern Poland are characterized by elevated concentrations of natural radioactive elements, including uranium and potassium [1]. However, their presence may be related to the use of fertilizers, especially phosphates [2].

The research aims to indicate the relationship between the type of land use and the activity of radionuclide concentration, which will allow for a better understanding of the mechanisms of their accumulation in the environment. The aim of this study was to determine the content of radioactive elements in various forms of land use in the area of Średnia Wieś. For this purpose, soils were collected from the following land uses: arable land, domestic garden, meadow and as a control, a forest area was appointed, which was the reserve "Grąd in Średnia Wieś". The following analyses were made: the granulometric composition was determined using the Bouyoucos method in Prószyński's modification, pH in H<sub>2</sub>O and 1 M KCl was determined potentiometrically, the content of organic carbon using the Tiurin method, hydrolytic acidity and the sum of basic cations using the Kappen method and the activity of radioactive isotopes: <sup>40</sup>K, <sup>235</sup>U, <sup>238</sup>U and <sup>137</sup>Cs using the NAIS 2x2 NaI(Tl) scintillation detector, which indicates gamma radiation emitted by radionuclides contained in the tested soil samples. As a result of the conducted studies, it was found that the type of land use has a significant influence on the content of radionuclides in the soil. Depending on the terrain, the use of fertilizers and the presence of plant cover, the results at individual sites differed, especially in the case of the isotopes <sup>40</sup>K, <sup>238</sup>U and <sup>137</sup>Cs. For agricultural land, a higher activity of <sup>40</sup>K and <sup>238</sup>U were found, which was associated with the use of fertilizers. The lower activity of the caesium isotope in forest use in relation to the others may be the result of plant cover, which inhibits the access of atmospheric precipitation, the main source of this nuclide.

[1] Lis J et al. Państwowy Instytut Geologiczny, Warszawa, 2010.

[2] Szaciłowski G. Journal of Radioanalytical and Nuclear Chemistry, 2023, 333:3424-3430, doi:10.1007/s10967-023-09241-4.

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## P9 RADIONUCLIDE ACTIVITY IN SOILS FROM SPA RESORT: A CASE STUDY IN HORYNIEC-ZDRÓJ

Michalina Nesterak<sup>1</sup>, Stanisław Ryzner<sup>2</sup>, Izabela Piotrowska<sup>2</sup>, Rafał Hakalla<sup>2</sup>, Iwona Makuch-Pietraś<sup>1</sup>

<sup>1</sup>Department of Nature Conservation and Landscape Ecology, University of Rzeszów, 4 Zelwerowicza Street, 35-601 Rzeszów, Poland

<sup>2</sup>Materials Spectroscopy Laboratory, University of Rzeszów, 1 Pigoń Street, 35-310 Rzeszów, Poland

Email address: imakuch@ur.edu.pl

Spa towns, due to their recreational and health-promoting functions, should be characterized by the best possible state of the natural environment. Unfortunately, like any other town, they are exposed to the impact of pollution related to the functioning of the town's inhabitants, e.g. dust emissions related to coal combustion [1] or fertilization [2], and these can contribute to increased radioactivity.

For this purpose, differently used soils were compared in the area of Horyniec Zdrój, including an agricultural field where fertilization is used. In addition, a control area was designated - a forest outside the city in order to compare with lands within the city. Soils were collected from the following land uses: arable land, domestic garden in two variants, and as a control, two areas of forest from different locations. The following analyses were made: the granulometric composition was determined using the Bouyoucos method in Prószyński's modification, pH in H<sub>2</sub>O and 1 M KCl was determined potentiometrically, the content of organic carbon using the Tiurin method, hydrolytic acidity and the sum of basic cations using the Kappen method and the activity of radioactive isotopes: <sup>40</sup>K, <sup>235</sup>U, <sup>238</sup>U using the NAIS 2x2 NaI(Tl) scintillation detector, which indicates gamma radiation emitted by radionuclides contained in the tested soil samples.

It was found that the designated forest area located outside the spa town was characterized by the lowest activity of the tested isotopes. Moreover, the activity of the tested isotopes in the city was the highest in agricultural land. This indicates a significant influence of factors such as dust fallout from coal combustion combined with the use of fertilizers, which affects the deterioration of the environment.

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[2] Szaciłowski G. J. *Radioanal. Nucl. Chem.*, 2023, 333:3424-3430, doi:10.1007/s10967-023-09241-4.

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## **P10 FORMAL AND LEGAL ASPECTS OF HARVESTING HONEY AND BEESWAX FROM BEEHIVES PLACED ON A CHEMICALLY PROTECTED CRANBERRY PLANTATION DURING ITS FLOWERING PERIOD**

Bartosz Piechowicz<sup>1</sup>, Paweł Siwulec<sup>1</sup>, Waldemar Grzegorzewski<sup>1</sup>, Iwona Piechowicz<sup>2</sup>, Marcin Pieniżek<sup>3</sup>

<sup>1</sup>Faculty of Biology and Nature Protection, University of Rzeszow, Poland

<sup>2</sup>Independent Researcher, Kolbuszowa, Poland

<sup>3</sup>Faculty of Technology and Life Sciences, Institute of Agricultural Sciences, Environmental Protection, and Shaping, University of Rzeszów, Poland

Email address: bpiechowicz@ur.edu.pl

When pollinating crops, honeybees (*Apis mellifera*) are exposed to agrochemicals, which can contaminate bee products such as honey and wax, ultimately affecting human consumption. This study aims to provide a formal and legal assessment of honey and beeswax obtained from beehives placed on an American cranberry (*Vaccinium macrocarpon*) plantation.

A field experiment was conducted on a commercial cranberry plantation in Nowiny (Lublin Voivodeship, Poland). Residues of active ingredients (AIs) used in crop protection, including fluazifop-P-butyl (applied as Fisilade Forte 150 EC), clethodim (Select Super 120 EC), and mesotrione (Mezotrion 100 SC), were analyzed in cranberry flowers, honey, and beeswax. Samples were collected at five time points: June 16, 23, and 30, and July 7 and 14, 2020.

At each sampling, 100 cranberry flowers were randomly collected from the plantation and placed in separate bottles containing petroleum ether. Additionally, bee products (unsealed honey and freshly secreted wax) were collected from four beehives situated within the plantation.

Residue extraction was performed using the multi-residue QuEChERS method. The resulting extracts were analyzed with an LC-QTOF-MS system, utilizing an Acquity UPLC chromatograph (Waters) coupled with a Synapt G2 mass spectrometer (Waters). Pesticide separation was conducted on an Acquity UPLC BEH C18 column (2.1 mm × 100 mm, 1.7 μm; Waters).

Based on the obtained results, exposure of the general population to pesticide residues was estimated using mathematical models. The percentage of the maximum residue level (MRL) was calculated for both honey and wax, while for honey alone, the percentage of acceptable daily intake (ADI) and the safe consumption level concerning AI residues were determined.

Fluazifop-P-butyl residues were detected in flowers during the first two sampling periods (up to 0.002 µg per flower). In honey, this AI was detected only in the first sampling period (0.001 µg per gram), whereas in wax, it was present throughout all sampling periods (up to 0.014 µg per gram). Clethodim residues were found in flowers in the first four periods (up to 0.06 µg per flower), in honey in two periods (up to 0.001 µg per gram), and in wax throughout all periods (up to 0.015 µg per gram). Mesotrione residues were present in all sampling periods, with the highest concentrations detected one day after the second treatment (July 6), reaching up to 0.824 µg per flower, 0.027 µg per gram of honey, and 0.658 µg per gram of wax.

The formal and legal residue assessment revealed that the collected honey, despite the pesticide treatments applied during the study, did not exceed permissible residue levels (2%, 2%, and 54% of the MRL for fluazifop-P-butyl, clethodim, and mesotrione, respectively) and can be safely marketed. The %ADI remained below 0.01 in all cases, and the estimated safe single-consumption level of honey concerning pesticide residues was 28 kg.

Due to the lack of data on the average daily consumption of beeswax, only the %MRL was calculated for wax. The obtained values were 28% (fluazifop-P-butyl), 30% (clethodim), and 1316% (mesotrione) of the permissible limit, indicating that beeswax harvested from the cranberry plantation cannot be legally marketed as a food product.

## **P11 THE EFFECT OF GRANULATION OF MAGNESIUM SORBENT ADDED TO SOIL IMPROVERS ON THE CONTENT OF HUMIC SUBSTANCES AND GROWTH *AVENA SATIVA* L.**

Justyna Koc-Jurczyk<sup>1</sup>, Agnieszka Podolak<sup>1</sup>, Edyta Seremak<sup>1</sup>, Sabina Filipek<sup>1</sup>, Łukasz Jurczyk<sup>1</sup>

<sup>1</sup>University of Rzeszów, Faculty of Technology and Natural Sciences, Institute of Agricultural Sciences, Land Management and Environmental Protection, Ćwiklińskiej 1a St., 35-601 Rzeszów, Poland

Email address: jkoc@ur.edu.pl

Among the effective ways to reduce waste mass - soil fertilisation with products derived from organic waste could be mentioned. Production of, so-called soil improvers, from such materials has not only an ecological but also an economic dimension. For example, coffee grounds or eggshells can improve increasing soil fertility, optimising chemical and physical parameters and promoting soil micro-organism activity [1]. Also, various inorganic wastes, such as residues derived from mineral sorbents production, can be utilized as the soil improvers additives. The study aimed to assess the influence of the granulation of waste magnesium sorbent on the content of humic substances in soil improvers and their effect on the germination and growth of common oats (*Avena sativa* L.). The improvers were prepared in the following ratios of coffee waste, eggshells and sorbent additive of 10:1:1, respectively, obtaining five mixture variants with different granulometric fractions of sorbent (<1 mm, >1 mm, >1.5 mm, >5 mm). All mixtures were analysed for humins and humic acids by determining the A2/4, A2/6, and A4/6 coefficients. The germination power and growth rate of *Avena sativa* were also examined. Analysing the value of the A2/4 coefficient, it was found the size of sorbent grains did not affect the content of humic acids. However, in the case of humins, a decrease in the coefficient was found with an increase in the grain size, possibly indicating a predominance of more easily decomposable compounds over lignins. When analysing the A2/6 coefficient, the granulation of the sorbent did not affect the contraction of humic acids, while in the fraction of humins, the content of easily degradable organic compounds increased more than lignins with the increase of grain size. In turn analysis of the A4/6 coefficient revealed that the size of sorbent grains had no effect on both humic acids or humins content. Interestingly, the application of the variant containing the largest grains (>5 mm) resulted in the highest efficiency of germination (73%), while the lowest (55%) was obtained with the improver that contained the smallest grains of sorbent. None of the tested soil improvers increased the growth rate of oats, regardless of the gradation. However, plants exposed to a mix containing sorbent of a diameter >1mm had significantly shorter stems than the control sample and the improver with add of eggshells. The implementation of organic

and mineral waste for fertiliser purposes is a step towards sustainability and a circular economy, crucial in the context of environmental protection and maintaining the long-term fertility of agricultural soils.

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## **P12 TOXICITY ASSESSMENT OF CALCIUM AND MAGNESIUM SORBENTS ON WATER PLANT *LEMNA MINOR* AND *SKELETONEMA MARINORI***

Agnieszka Podolak<sup>1</sup>, Zuzanna Sylwestrzak<sup>2</sup>, Samanta Nadozirna<sup>1</sup>, Justyna Koc-Jurczyk<sup>1</sup>, Łukasz Jurczyk<sup>1</sup>, Waldemar Prokop<sup>3</sup>

<sup>1</sup>University of Rzeszów, Faculty of Technology and Natural Sciences, Institute of Agricultural Sciences, Land Management and Environmental Protection, Ćwiklińskiej 1a St., 35-601 Rzeszów, Poland

<sup>2</sup>University of Gdańsk, Faculty of Oceanography and Geography, Piłsudskiego 46, 81-378 Gdynia, Poland

<sup>3</sup>C4IN, Rudna Wielka 27d, 36-054 Rudna Wielka, Poland

Email address: apodolak@ur.edu.pl

Sorbents are insoluble materials used to absorb various types of pollutants through absorption or adsorption mechanisms. This solution is widely used in industrial processes but also in environmental engineering to bind and remove pollutants from air, water or in soil remediation [1]. However, while they are generally effective in reducing the toxicity of other compounds, some sorbents can also exhibit inherent toxicity [2]. The aim of the presented research is to evaluate the effect of extracts from calcium and magnesium sorbents on the growth and development of *L. minor* and *S. marinoi* as model organisms in ecotoxicological studies.

Water extracts of Ca sorbents differing in sorbent activation and Mg sorbents differing in the degree of raw material fragmentation were tested. An acute toxicity test for *L. minor* was used according to the modified methodology based on ISO 20227:2017 [3]. Algal growth inhibition tests were performed in accordance with the OECD [4] methodology on the diatom strain *S. marinoi* (BA98), maintained as a monoculture in the Collection of Baltic Algae Cultures (CCBA) at the University of Gdańsk.

Significant differences were observed between the effects of Ca and Mg sorbents. The studies showed that the Ca sorbent had an unfavorable effect on both tested species, while the Mg sorbent did not show such an effect, and in some variants had a beneficial effect on the analyzed organisms.

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## **P13 BACTERIOPHAGES AS A BACTERIAL CONTAMINATION CONTROL AGENT: ISOLATION AND CHARACTERIZATION OF LYTIC PHAGES AGAINST *ESCHERICHIA COLI***

Leszek Potocki<sup>1</sup>, Iwona Gierlicka<sup>1</sup>, Mariusz Worek<sup>2</sup>, Dariusz Martynowski<sup>3</sup>, Krzysztof Pawlik<sup>3</sup>

<sup>1</sup>Collegium Medicum, Faculty of Biotechnology, University of Rzeszów, Pigoń 1, 35-310 Rzeszów, Poland

<sup>2</sup>Collegium Medicum, Department of Microbiology, University of Rzeszów, Al. W. Kopisto 2a, 35-959 Rzeszów, Poland

<sup>3</sup>Hirsfeld Institute of Immunology and Experimental Therapy, Polish Academy of Sciences, Weigla 12, 54-114 Wrocław, Poland

Email address: lpotocki@ur.edu.pl

The increasing prevalence of multidrug-resistant *Escherichia coli* is a significant emerging environmental contaminant that poses a critical threat to human and environmental health. Treatment of *E. coli* infections is becoming increasingly challenging due to the rapid emergence of resistance to first-line antimicrobials. This necessitates the search for alternative antibiotic therapies to combat such infections and reduce the spread of resistance in the environment, particularly in soil, surface water, and bottom sediments. Bacteriophages are considered a promising solution for both therapeutic and bioremediation applications [1,2]. The aim of this study was to isolate, characterise and evaluate the potential use of bacteriophages for the control of *E. coli* infections, including those with ESBL-type resistance, and for environmental decontamination. Three novel phages against *E. coli* obtained from a mixture of phages isolated from wastewater, were characterised *in vitro*. The genome sizes were estimated to be 167,868 bp, 51,323 bp and 50,383 bp, respectively, and TEM analysis revealed that they belong to the order *Caudovirales*, families *Myoviridae* and *Siphoviridae*. The isolated phages showed lytic activity against other *Enterobacteriaceae* species, including *Shigella sonnei* ATCC 25931 and *Enterobacter aerogenes* PCM 532. The isolated phages exhibited a latency of 10 minutes and large burst sizes (140 PFU and 120 PFU per infected cell for two of them), enhancing their potential for commercial and environmental applications. The phage mixture and two subisolates had the greatest effect on bacterial cell reduction, while the third subisolate exhibited a narrower host range. All phages reduced biofilm cell counts in ESBL *E. coli* strains and environmental isolates, even at 1% dilution. The phages showed good tolerance to a wide range of pH and temperature and remained stable in simulated gastric and intestinal juices. Furthermore, the bactericidal efficacy of these phages was evaluated under simulated water contamination conditions using environmental *E. coli* isolates. Non-encapsulated phages caused a statistically significant reduction in mean

cell counts of seven environmental *E. coli* isolates (2.31 log reduction) and a 1 log reduction for one of the subisolates at an MOI of 100. Alginate/CaCO<sub>3</sub> encapsulated phage beads also demonstrated bacterial reduction, though to a lesser extent, with a 0.7 log reduction for the phage mixture and varying reductions for the subisolates. The promising biological properties of these phages, including lytic activity, stability, and biofilm reduction, suggest that they are viable candidates as alternatives to antibiotics and for environmental decontamination, addressing the challenge of emerging environmental contaminants.

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## **P14 BACTERIOPHAGES AS A TOOL IN THE FIGHT AGAINST ANTIBIOTIC RESISTANCE: ISOLATION AND CHARACTERIZATION OF LYTIC PHAGES AGAINST MULTIDRUG-RESISTANT *PSEUDOMONAS AERUGINOSA***

Leszek Potocki<sup>1</sup>, Jakub Ochmerak<sup>1</sup>, Kacper Osiadły<sup>1</sup>, Jakub Mazur<sup>1</sup>, Małgorzata Kus-Liśkiewicz<sup>1</sup>

<sup>1</sup>Collegium Medicum, Faculty of Biotechnology, University of Rzeszów, Pigonia 1, 35-310 Rzeszów, Poland

Email address: [lpotocki@ur.edu.pl](mailto:lpotocki@ur.edu.pl); [jo117749@stud.ur.edu.pl](mailto:jo117749@stud.ur.edu.pl)

The rise of antibiotic resistance, particularly among opportunistic pathogens such as *Pseudomonas aeruginosa*, is a significant emerging environmental contaminant that poses a serious threat to public health. *P. aeruginosa*, a major cause of pneumonia, bloodstream infections and cystic fibrosis, is increasingly multi-drug resistant (MDR), complicating treatment and leading to poorer health outcomes and increased mortality. The spread of resistant strains in water and soil environments, necessitates the urgent search for alternative control strategies [1,2].

In this study, we analysed the antibiotic resistance profile of *P. aeruginosa* isolates and the presence of virulence factors (motility, biofilm formation, pyocyanin and pyoverdinin production).

The *P. aeruginosa* isolates showed resistance to a broad spectrum of antibiotics, including beta-lactams, cephalosporins, carbapenems, quinolones and partial resistance to aminoglycosides. The observed multidrug resistance led to the second phase of the study, which aimed to isolate lytic bacteriophages against *P. aeruginosa* as potential alternative therapeutic agents and bioremediation tools.

The lytic bacteriophage, vB\_Pa-G1, showed high strain specificity, infecting only some of the *P. aeruginosa* tested isolates. Its morphology, characterised by clear plaques and large translucent zones, suggests a lytic nature, a crucial feature for its therapeutic and bioremediation potential. The bacteriophage also showed lytic activity at the lowest viral concentration at an MOI of 0.001. Furthermore, the vB\_Pa-G1 bacteriophage shows lytic stability, being resistant to high temperatures, alkaline pH, and gastric and intestinal juices. In addition, the phage exhibited rapid adsorption capacity, a short latency period, and a large burst size. These results suggest that the isolated vB\_Pa-G1 phage has favourable biological properties for the treatment of *Pseudomonas aeruginosa* infections, as well as potential applications in the bioremediation of environments contaminated with resistant strains.

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## **P15 ASSESSMENT OF THE ABILITY OF URBAN GREEN AREAS IN RZESZÓW TO RETAIN POLLUTANTS IN THE FORM OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) ON THE EXAMPLE OF THE ANALYSIS OF ENVIRONMENTAL SOIL SAMPLES**

Amelia Gargała<sup>1</sup>, Agnieszka Gruchot<sup>1</sup>, Zuzanna Hanus<sup>1</sup>, Roksana Szkoła<sup>1</sup>, Magdalena Słowik-Borowiec<sup>1</sup>

<sup>1</sup>Department of Biotechnology, Collegium Medicum, University of Rzeszow, 1 Pigoń St., 35-310 Rzeszów, Poland

Email address: mslowik@ur.edu.pl

In this study, the concentration of polycyclic aromatic hydrocarbons (PAHs) in soil samples from urban parks in Rzeszów was investigated to assess the level of environmental pollution. Samples for testing were taken from 15 parks both in the city centre and surrounding areas. The scope of the research included the determination of 13 PAHs (acenaphthylene, fluorene, phenanthrene, anthracene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3)pyrene, dibenzo(a,h)anthracene, benzo(ghi)perylene, and benzo(a)pyrene). The PHAs content in soil was assessed with the QuEChERS multiresidue method, combined with gas chromatography coupled with tandem mass spectrometry (GC-MS/MS) [1]. The results highlight the relationship between PAH levels and the proximity of major communication routes - in all cases, higher concentrations were detected in samples from the edges of the parks (from 0.457 to 0.002 mg/kg), compared to samples collected from the central part - inside the park (from 0.205 to 0.001 mg/kg). The study showed that the highest concentration in the tested soil was found for pyrene (0.457 mg/kg), while the lowest for fluorene (0.006 mg/kg). In the case of chrysene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indene(1,2,3cd)pyrene and benzo[g,h,i]perylene, the maximum residue limits (MRLs) were exceeded.

These results suggest that green areas in urban environments are exposed to significant anthropogenic pollution, therefore requiring their continuous monitoring.

[1] Słowik-Borowiec M. et al. *Molecules*, 2022; 27, doi:10.3390/molecules27072140.

*This research was supported by the Minister of Science of the Republic of Poland under the Programme „Regional initiative of excellence”. Agreement No. RID/SP/0010/2024/1.*

## **P16 OCCURRENCE AND DISTRIBUTION OF ANTIBIOTICS IN TECHNICAL SNOW PRODUCED ON SKI SLOPES IN SOUTHERN POLAND AND SLOVAKIA**

Klaudia Stankiewicz<sup>1</sup>, Justyna Prajsnar<sup>2</sup>, Anna Lenart-Boroń<sup>1</sup>

<sup>1</sup>Department of Microbiology and Biomonitoring, Faculty of Agriculture and Economics, University of Agriculture in Kraków, Poland

<sup>2</sup>Jerzy Haber Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences, Kraków, Poland

Email address: klaudia.kulik@student.urk.edu.pl

The contamination of surface waters with antibiotics, primarily originating from wastewater treatment plants, poses a significant environmental and public health challenge, particularly in mountainous regions where these waters are used for technical snow production. River water pollution by antibiotics is strongly associated with high tourist activity and anthropogenic pressure in these areas. Periodic peaks in tourist activity lead to increased wastewater production, which can overload treatment plants. These facilities are often unable to fully eliminate micropollutants, resulting in their release into the aquatic environment. Ski resorts in southern Poland and Slovakia rely on river water to produce technical snow using snow cannons, potentially transferring antibiotics and other micropollutants from contaminated water to snow. This study investigates the occurrence and distribution of antibiotics in river water and technical snow produced on ski slopes in these regions.

Water and snow samples were collected from twelve ski stations during the winter seasons of 2021/2022 and 2022/2023. The ski resorts are located near the rivers: Białka, Biały Dunajec, Raba, Żylica in southern Poland and Salatinski Potok in Slovakia. Sampling sites included river water intakes, retention reservoirs, and technical snow produced by snow cannons. This research was focused on antibiotics in an unchanged, antimicrobial-active form, which in sub-lethal concentrations may affect the development of antibiotic resistance among bacteria. Quantitative and qualitative analysis of water samples was carried out using Ultra High Performance Liquid Chromatography (UHPLC) equipped with a tandem mass spectrometry detector (Agilent 6460 Triple Quad Detector, Santa Clara, CA, USA), which allowed to detect the presence of antibiotics at ng/L concentrations. A total of 21 antibiotics were monitored in the collected water and snow samples (n=62). The presence of antibiotics above the detection limit was discovered both in water and technical snow. Qualitative analysis revealed the presence of 14 antibiotics in all samples. The most frequently occurring were: clindamycin (66% samples), sulfamethoxazole (42%), enrofloxacin (35%) and trimethoprim (31%). The highest concentrations of these antibiotics were recorded in the Raba River, with a significant reduction observed in the levels of these compounds in the technical snow produced from these river waters. The findings highlight the

potential for antibiotic contamination in recreational environments, raising concerns about human exposure and the spread of antibiotic resistance.

## **P17 ADVANCED OXIDATION PROCESSES FOR PHARMACEUTICAL REMOVAL FROM WASTEWATER - ENVIRONMENTAL HEALTH AND ECOTOXICOLOGY RISK**

Andrzej R. Reindl<sup>1</sup>, Zuzanna Sylwestrzak<sup>2</sup>, Agnieszka Fiszka Borzyszkowska<sup>1</sup>, Lidia Wolska<sup>1</sup>

<sup>1</sup>Medical University of Gdansk, Faculty of Health Sciences, Department of Environmental Toxicology, Dębowa 23A Str, 80-204 Gdansk, Poland

<sup>2</sup>University of Gdansk, Faculty of Oceanography and Geography, Al. Pilsudskiego 46, 81-378 Gdynia, Poland

Email address: [zuzanna.sylwestrzak@ug.edu.pl](mailto:zuzanna.sylwestrzak@ug.edu.pl)

Hospital wastewater is a significant source of pharmaceutical pollutants in aquatic environments, containing high concentrations of antibiotics, cytostatics, and other biologically active compounds. Antibiotics, particularly macrolides and quinolones, contribute to the selection of antibiotic-resistant bacteria, posing serious ecological and public health risks. The presence of pharmaceutical residues in wastewater disrupts natural microbial communities and affects ecosystem balance. Advanced Oxidation Processes (AOPs), including the Fenton process, utilize hydroxyl radicals to efficiently degrade pharmaceutical contaminants. Due to its high effectiveness, cost-efficiency, and environmental safety, the Fenton process is a promising approach for hospital wastewater treatment, effectively reducing the pharmaceutical pollution.

The analysis of the Fenton oxidation process using different catalysts (FeSO<sub>4</sub>, CuSO<sub>4</sub>, MnSO<sub>4</sub>) for a model mixture of antibiotics and pharmaceuticals demonstrates the high efficiency of this relatively simple method. Subtle differences in degradation rates were observed depending on the antibiotic class and the type of catalyst used. The highest degradation efficiency was achieved for beta-lactams, tetracyclines, and sulfonamides. Fluoroquinolones, as well as certain  $\beta$ -blockers and analgesics, exhibited slightly lower degradation rates.

Experimental toxicity assessments of municipal wastewater influenced by hospital effluents before and after Fenton oxidation with different catalysts also revealed notable variations. The Microtox assay indicated that raw wastewater had low toxicity, however, following intensive oxidation via the Fenton process, toxicity levels increased. This results suggests the formation of toxic by-products or residual hydroxyl radicals affecting toxicity outcomes. Despite this, ecotoxicological studies on plant-associated microorganisms indicated that municipal wastewater treated by the Fenton process did not exhibit toxicity to the Baltic diatom *Skeletonema costatum*. In a series of ecotoxicological tests, a stimulation of *S. costatum* growth of up to 50% and 100% was observed after 3 and 7 days, whereas untreated wastewater inhibited algal cell growth.

## P18 TOWARD POLLEN-BASED HETEROSTRUCTURES CONTAINING METAL OXIDES AND PHOSPHATES

Anna Tomaszewska<sup>1</sup>, Magdalena Kulpa-Greszta<sup>1</sup>, Idalia Kasprzyk<sup>2</sup>, Wiktoria Wałęga<sup>1</sup>, Piotr Krzemiński<sup>3</sup>, Robert Pązik<sup>1</sup>

<sup>1</sup>Faculty of Biotechnology, Collegium Medicum, University of Rzeszow, ul. Pigońia 1, 35-310 Rzeszow, Poland

<sup>2</sup>Faculty of Biology and Nature Protection, University of Rzeszow, ul. Zelwerowicza 4, 35-601 Rzeszow, Poland

<sup>3</sup>Center for Microelectronics and Nanotechnology, Institute of Materials Engineering, Faculty of Exact and Technical Sciences, University of Rzeszow, Al. Rejtana 16, 35-959 Rzeszow, Poland

Email address: [atomaszewska@ur.edu.pl](mailto:atomaszewska@ur.edu.pl)

This study focuses on the synthesis of modern, functional heterostructures derived from the natural pollen of *Ambrosia artemisiifolia* L. using a multistep preparation technique. The process involves pollen purification, surface phosphonation, chemisorption of various metal cations, and subsequent thermal treatment. We specifically examine the chemical transformation of Fe<sup>3+</sup> adsorbed cations and their role in the formation of an inorganic layer primarily composed of iron oxide and phosphate. The layer serves as a versatile starting material for further modifications and applications.

Our approach aligns with sustainable development principles by optimizing substrate use and minimizing environmental impact. The resulting products possess potential for applications in water remediation systems, sorbents, catalytic agents, and biomimetic materials, as they retain the original pollen morphology. To characterize their properties, we employed XRD, FTIR-ATR, and SEM techniques. Our findings highlight the critical role of annealing temperature in inorganic layer formation, while emphasizing the need for careful control of metal cations concentration.

## P19 ABIOTIC AND BIOTIC AGING OF MICROPLASTICS - INFLUENCE ON THE COAGULATION PROCESS

Sabina Ziembowicz<sup>1</sup>, Małgorzata Kida<sup>1</sup>, Monika Zdeb<sup>2</sup>

<sup>1</sup>Department of Chemistry and Environmental Engineering, Rzeszów University of Technology, 35-959 Rzeszów, Powstańców Warszawy Avenue 6, Poland

<sup>2</sup>Department of Water Purification and Protection, Rzeszów University of Technology, 35-959 Rzeszów, Powstańców Warszawy Avenue 6, Poland

Email address: s.ziembowicz@prz.edu.pl

Coagulation is a well-known and widely used technique for removing suspended particles; however, there is limited data on its effectiveness in eliminating microplastics (MPs). The research available on MPs removal through coagulation is still in a preliminary stage, and no studies comprehensively investigate the mechanism, effectiveness of removal and the factors influencing the efficiency of this process. A significant limitation of the research conducted so far on the coagulation process to MPs elimination is the failure to consider that microplastic particles present in environmental conditions are transformed/aged under the influence of abiotic and biotic factors. These particles change not only their appearance, size, mass or density, but also their surface properties and chemical composition. Such changes may either enhance or hinder the efficiency of microplastic elimination.

The primary goal of this research was to analyse the impact of biotic and abiotic aging of polyethylene (PE) microplastics on the effectiveness of coagulation. Polyethylene (34-50 µm) was selected due to its widespread presence in the environment. The influence of mechanical stress (shaking in water, shaking in water with sand addition), thermal oxidation (5; 25 and 60°C), chemical treatment (HCl, NaOH, CH<sub>3</sub>OH, H<sub>2</sub>O<sub>2</sub>, KMnO<sub>4</sub>, Na<sub>2</sub>S<sub>2</sub>O<sub>8</sub>), and biotic aging (*Pseudomonas aeruginosa*, 37°C) on changes in PE microplastic properties and its removal efficiency through classical coagulation were investigated. The removal of primary microplastics (not aged) was 29.63%. All tested factors influenced the degree of microplastic elimination. Most aging conditions enhanced PE removal. The highest removal efficiencies were observed for PE aged with 0.1M NaOH (80.2%, 60°C, 28 days), 0.1M KMnO<sub>4</sub> (71%, 60°C, 14 days), 0.1M Na<sub>2</sub>S<sub>2</sub>O<sub>8</sub> (68.8%, 60°C, 14 days), and biofouling formation after 28 days (approximately 67%). In contrast, the lowest removal yields were recorded for PE incubated in methanol and hydrogen peroxide. The duration and temperature of chemical incubation were significant factors influencing the results. The efficiency of PE elimination after mechanical and thermal aging did not exceed 60%.

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## **P20 THE INFLUENCE OF PLACE OF RESIDENCE ON CHANGES IN CHROMIUM CONCENTRATIONS IN MATERNAL VENOUS BLOOD AND UMBILICAL CORD BLOOD OF NEWBORNS FROM THE PODKARPACIE PROVINCE**

Barbara Zych<sup>1</sup>, Anna Gorka<sup>2</sup>

<sup>1</sup>Faculty of Health Sciences and Psychology, Medical College of Rzeszow University, Warzywna 1a, 35-310 Rzeszów, Poland

<sup>2</sup> Faculty of Biotechnology, University of Rzeszow, Pigońia 1, 35-310 Rzeszów, Poland

Email address: bzych@ur.edu.pl

Chromium is an essential bio-element that has a significant impact on the proper functioning of the human body. It affects the metabolism of carbohydrates, lipids and proteins. Cr(III) increases insulin sensitivity by activating insulin receptor kinase. It participates in antioxidant processes and plays a role in immune system function. It is a component of many enzymes and is a catalyst for many chemical reactions [1]. Both deficiency and excess of chromium can be harmful to the body [2,3]. To gain a better understanding of the human body's exposure to this element, we analyzed chromium concentrations (in maternal venous blood and umbilical cord blood of newborns born in the Podkarpackie province) in relation to: 1. the location of the place of residence (urban vs. rural); 2. the location of the road in the immediate place of residence, without restriction to the county in which the respondents live (direct vs. nearby vs. distant).

The material consisted of 201 mother-child blood samples, in which chromium concentrations were determined by graphite furnace atomic absorption spectrometry (GF-AAS). The determination of each sample was carried out in two measurement series. Chromium concentrations were compared with values in plasma, which is a certified reference material. The results obtained were subjected to statistical analysis, taking  $p < 0.05$  as significant.

It was shown that the mean concentration of chromium in maternal blood and cord blood of newborns according to the location of residence (mother:  $30.9 \pm 21.6$  nmol/dm<sup>3</sup> vs.  $57.9 \pm 159.1$  nmol/dm<sup>3</sup>,  $p = 0.049$ ; newborn:  $36.3 \pm 44.4$  nmol/dm<sup>3</sup> vs.  $37.0 \pm 42.9$  nmol/dm<sup>3</sup>,  $p = 0.454$ ) and distance from the road in the immediate area (mother:  $38.7 \pm 73.6$  nmol/dm<sup>3</sup> vs.  $47.7 \pm 148.7$  nmol/dm<sup>3</sup> vs.  $52.8 \pm 117.1$  nmol/dm<sup>3</sup>,  $p = 0.797$ ; newborn:  $34.4 \pm 40.0$  nmol/dm<sup>3</sup> vs.  $40.4 \pm 54.6$  nmol/dm<sup>3</sup> vs.  $35.5 \pm 24.3$  nmol/dm<sup>3</sup>,  $p = 0.675$ ) differentiated the study groups from one another in terms of residence.

This preliminary study revealed the existence of a correlation between increased exposure to chromium of mothers living in rural areas, which can threaten both maternal and fetal health.

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R Z E S Z Ó W U N I V E R S I T Y P R E S S

35-310 Rzeszów, ul. prof. S. Pigoń 6, tel.: 17 872 13 69, tel./faks 17 872 14 26

e-mail: [wydawnictwo@ur.edu.pl](mailto:wydawnictwo@ur.edu.pl); <https://wydawnictwo.ur.edu.pl>