CHEMISTRY
SYMPOSIUM
BUDVA

1st Congress of Chemists of Montenegro

CHEMCONMNE 2026

May 26–29, 2026
Budva, Montenegro

Book of Abstracts

Chemical Society of Montenegro

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1st Congress of Chemists of Montenegro
May 26–29, 2026, Budva, Montenegro

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Welcome Message

Dear Colleagues,

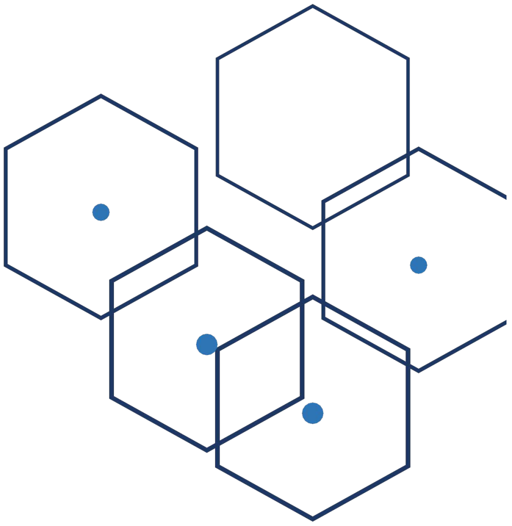
On behalf of the Organizing Committee, it is my great pleasure to invite you to the 1st Congress of Chemists of Montenegro – CHEMCONMNE 2026, which will be held from May 26 to 29, 2026, in Budva, Montenegro.

This conference is organized by the Chemical Society of Montenegro, in cooperation with the Faculty of Natural Sciences and Mathematics, University of Montenegro, in honor of the enrollment of the first generation of students in the Chemistry study program in Montenegro.

CHEMCONMNE 2026 will provide a forum for the exchange of ideas on recent advances in research and development in environmental chemistry and technology, bringing together participants from industry, research institutions, and academia.

We are looking forward to seeing you in Montenegro — welcome!

Željko Jaćimović
Conference Chairman



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Tuesday, 26/05/2026

12^{00} - 18^{00}	Registration of participants
19^{00}	Welcome Cocktail

Wednesday, 27/05/2026

Chair person: Ž. Jaćimović and M. Bigović

9^{00} - 9^{20}	Opening ceremony
9^{20} - 10^{20}	**Plenary Lecture 1:** **Zinc and vanadium coordination compounds as potential antidiabetic agents** ***Franc Perdih,*** *Faculty of Chemistry and Chemical Technology, University of Ljubljana*
10^{20} - 10^{35}	Coffee break ☕
10^{35} - 11^{05}	**Session Lesson 1:** **Monocarbonyl analogs of curcumin (MACs): versatile and readily accessible organic compounds with diverse biological activities** ***Jane Bogdanov,*** *Institute of Chemistry, Faculty of Natural Sciences and Mathemetics, Ss. Cyril and Methodius University in Skopje*

Oral Session 11^{05} - 11^{50}

11^{05} - 11^{20}	ICP-MS Based Study of Lanthanide Ion Sorption onto Iron Nanoparticles Encapsulated in Alginate Hydrogel *Nikolina Ilić, Faculty of Science, University of Zagreb*
11^{20} - 11^{35}	From complex polymer lignin to multifunctional nanoparticles *Jelena Papan Đaniš, Faculty of Chemistry and Chemical technology, University of Ljubljana*
11^{35} - 11^{50}	Synthesis and crystal structure of Co(II) complex with *5-(4-bromophenyl)-3-methyl-1H-pyrazole* *David Kočović, Institute for medicines and medical devices of Montenegro*

11^{50} - 12^{20}	**Session Lesson 2:** **Synthesis of new Schiff bases with thiocarbohydrazide and optimization of reaction conditions** ***Miljan Bigović,*** *Faculty of Natural Sciences and Mathematics, University of Montenegro*
12^{20} - 12^{40}	Sponsor presentation **Analysis doo**

Chair person: Polonca Trebše and M. Radanović

12^{40} - 13^{10}	**Session Lesson 3:** **Nano-Iron Power: A Cutting-Edge Solution for Heavy Metal Removal from Water** ***Ivan Nemet,*** *Faculty of Science, University of Zagreb*
13^{10} - 14^{30}	Lunch break
14^{30} - 15^{30}	**Plenary lecture 2:** **Application of protein markers in the evaluation of hip dysplasia in Tornjak breed** ***Atifa Ajanović,*** *Veterinary faculty, University of Sarajevo*
15^{30} - 15^{50}	Sponsor presentation **MC Labor**
15^{50} - 16^{05}	Coffee break ☕

Chair person: Ž. Jaćimović

16^{05} - 16^{35}	**Session Lesson 4:** **Industrial Decarbonization by Concentrating Solar Power Plants – Absorber Coatings** ***Ivan Jerman,*** *National Chemical Institute*

Poster session 16^{35} - 18^{35}

19^{30} - 21^{00}	Budva by night /Old Town Budva

Thursday, 28/05/2026

Chair person: Dijana Đurović and Snežana Pantović

9^{00} - 10^{00}	**Plenary Lecture 1:** **PFAS: Historical Context, Current Challenges, and Future Directions** ***Vladimir Beškoski,*** *Faculty of Chemistry, University of Belgrade*
10^{00} - 10^{15}	Coffee break
10^{15} - 10^{45}	**Session Lesson 1** **The Hidden Chemistry of a Swim: What's in the Water?** ***Polonca Trebše,*** *Faculty of Health Sciences, University of Ljubljana*
10^{45} - 11^{15}	**Session Lesson 2** **Petroleum as a native material in geological conditions and as anthropogenic material in the environment** ***Branimir Jovančićević,*** *Faculty of Chemistry, University of Belgrade*
11^{15} - 11^{35}	Sponsor presentation **Superlab**

Chair person: Ljiljana Vojinović - Ješić and Željko Jaćimović

11^{35} - 12^{35}	**Plenary Lecture 2** **Characteristics of materials for the manufacture of orthopedic implants and their impact on the human body** ***Fehim Korać,*** *Faculty of Science, University of Sarajevo*
12^{35} - 12^{50}	Tunable preparation of methano and furano-fused fullerenes and their applications *Veselin Maslak*
12^{50} - 14^{15}	Lunch break
14^{15} - 15^{15}	**Plenary lecture 3** **Expanding the Functional Landscape of Metal Complexes: From Concept to Application** ***Mirjana Radanović,*** *Faculty of Sciences, University of Novi Sad*
15^{15} - 15^{35}	Sponsor presentation **Shimadzu**
15^{35} - 15^{50}	Coffee break

Poster session 15^{50} - 17^{50}

20^{30} - 23^{30}	Gala dinner

Friday, 29/05/2026

9^{00} - 10^{15}	Closing ceremony and Awards
10^{15} - 10^{30}	Coffee break ☕
10^{30}	Participant departure

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Poster sessions

PO1 Wednesday, 27/05/2026
16:35 - 18:35

PO1-1 - SPONSOR: PRIMAlab

PO1-2 - A. Šapčanin, G. Jančan, M. Malenica, Ž. Jaćimović - Chemical-analytical methods for determination of CBD in selected forenzic samples

PO1-3 - A. Mujezin, A. Ajanović, I. Alilović, A. Ajanović, A. Smajlović, A. Magoda, E. Toromanović, V. Simić, I. Tahirović - Serum Lipid Profile in Male Wistar Rats Treated with High-Fat and High-Carbohydrate Diets

PO1-4 - A. Radović, Ž. Jaćimović, M. Bigović, B. Kandić, N. Latinović - Fungicidal effect of the newly synthesized complex $Mn_2(L\text{-}H)_2 \cdot H_2O$ on fungus *Botryosphaeria* dothidea

PO1-5 – A. Radović, Ž. Jaćimović, M. Vujić, B. Kandić, N. Latinović - In vitro studies of the newly synthesized complex $Co(L\text{-}H)_2 \cdot 2H_2O$ against the fungus *Diaporthe ampelina*

PO1-6 – A. Ajanović, A. Mujezin, A. Ajanović, I. Alilović, I. Tahirović, E. Sofić - Changes in Cholesterol Concentrations in Human Blood with Age

PO1-7 – B. K. Vulićević, V. Kastratović - Competitive adsorption of selected heavy metals on calcite

PO1-8 – D. Kočović, A. Šapčanin, S. Hamidović, B. Imamović, Ž. Jaćimović - Synthesis, characterization and bactericidal properties of Cu(II), Pd(II) and Pt(II) complexes with 4-methylpyrazole

PO1-9 – G. Jančan, A. Šapčanin, Ž. Jaćimović - HPLC test method for the determination of cannabinoids in different samples in routine quality control

PO1-10 - I. Cvijetić, P. Ristivojević - COSMO-RS screening of hydrophobic deep eutectic solvents for aristolochic acids extraction

PO1-11 – M. Kaluđerović, P. Ristivojević, D. D. Zagorac, M. Bigović - Comparison of ultrasonic bath and probe for NADES-assisted extraction of carotenoids

PO1-12 - M. Dimitrijević, P. Thomashausen, M. Bogdanović, Lj. S. Vojinović-Ješić, I. Đ. Borišev, G. N. Kaluđerović, M. M. Radanović - Synthesis and biological evaluation of new pyrrolo[3,4-c]quinoline-1,3-dione–chalcone hybrids as dihydroorotate dehydrogenase inhibitors

PO1-13 – M. S. Regojević, Lj. S. Vojinović-Ješić, B. B. Hollo, M. V. Rodić, M. M. Radanović - Novel 2,6-diacetylpyridine derivative zinc(II) complexes from one-step synthesis

PO1-14 – M. S. Regojević, P. Thomashausen, M. G. Bogdanović, Lj. S. Vojinović-Ješić, I. Đ. Borišev, G. N. Kaluđerović, M. M. Radanović— Silver(I) complex with 3-(1-Pyrazolyl)-L-alanine: Structure and antioxidant activity

PO1-15 – M. G. Dimitrijević, M. D. Joksović - Docking-guided design and synthesis of L-DOPA–pyrrolo[3,4-c]quinoline-1,3-dione hybrids as potential hDHODH Inhibitors

PO1-16 - M. Stanković, N. Lj. Stevanović, T. P. Andrejević, D. P. Ašanin, B. V. Pantović, S. Š. Bogojević, B. Đ. Glišić - Antimicrobial Properties of Silver(I) Complexes with Miconazole

PO1-17 – M. Stanković, T. P. Andrejević, N. Lj. Stevanović, D. P. Ašanin, I. Vučenović, B. V. Pantović, B. Đ. Glišić - Investigation of the Binding Affinity of a Silver(I) Complex with 1,6-Naphthyridine toward Biologically Relevant Molecules

PO1-18 – M. Bigović, M. Roganović, V. Maslak, M. Kaluđerović, S. Vujović, D. Radinović, M. Jovanović - Determination of the composition of human thrombi by the method of FTIR spectroscopy

PO1-19 - M. Bigović, K. Pete, M. Kaluđerović, N. Prlainović - Disubstituted Schiff Bases Synthesis and ABTS Antioxidant Evaluation

PO1-20 – M. Bigović, M. Bakrač, Optimization of the synthesis of new Schiff bases of aldehydes with thiocarbohydrazide using an ultrasonic probe

PO1-21 – M. Bigović, M. Đođić, M. Kaluđerović, Đ. Nakarada, A. Malović - Synthesis and characterization of Schiff bases of some natural aldehydes with thiocarbohydrazide

PO1-22 – M. Milić, M. Ognjanović, B. Dojčinović, Ž. Jaćimović. D. Stanković, B. Antić - Single-core magnetite nanoparticles as dual-function agents heat generators and Peroxymonosulfate nanocatalysts for dye degradation

PO1-23 – S. Pantović, M. Roganović, T. Vojinović - Plasma Proteome Modulation and Cytokine Removal During Membrane Plasmapheresis in Post-Viral Neuroinflammation: A Case-Based Medical Chemistry Insight

PO1-24 – T. Milivojević, M. Ranković, N. Gavrilov, A. Jevremović, B. N. Vasiljević, D. B. Bogdanović, M. M. Rakić - Exploration of PFAS Degradation over Ti-Supported Ti-suboxides

PO2 Thursday, 28/05/2026

15^{50} - 17^{50}

PO2-1 – A. Šapčanin, F. Bikić, G. Jančan, Ž. Jaćimović - The assessment of potential fitoremediation purpose of selected plants in Zenica municipality

PO2-2 – A. Šapčanin, F. Bikić, G. Jančan, Ž. Jaćimović - The health risk assessment posed to heavy metals in the topsoil and plant cultivars of Zenica municipality

PO2-3 - A. Chiznov - Scientific Misconduct in Chemistry and Related Areas how to recognize it and defend -

PO2-4 – A. Race, I. Jerman, N. Bošković - Comparative Microscopy Application of Raman and FTIR Spectroscopy in the Identification of Microplastics from Sediments

PO2-5 – B. D. Vratnica, P. Šofranac, S. Krivokapić, S. Perović - Variability in Yield and Thymol/Carvacrol content of Hydrodistilled Essential oil from Winter Savory

PO2-6 – Đ. Nakarada, Z. Latinković, M. Mojović - Influence of Liposomal Encapsulation on the Antioxidant Properties of *Vaccinium myrtillus* Extract

PO2-7 – Đ. Nakarada, N. Preradović, M. Mojović - Liposomal Delivery of *Inonotus obliquus* Extract in a Dermocosmetic Cream: Antioxidant Activity and Penetration Studied by EPR

PO2-8 – J. Šćepanović, M. Milićević, D. Radonjić, D. Vuksanović - Possibilities of using Electrical and electronic waste

PO2-9 – K. Laketić, B. K. Vulićević, I. Bulatović, S. Laschi, I. Palchetti - Electrochemical sensor for zinc monitoring in mining-impacted waters

PO2-10 – L. Andrić, A. Orahovac, D. Đurović - Risk assessment of acrylamide in potato chips in Montenegro

PO2-11 - M. Roganović, T. Antunović, B. Vujović, S. Vujović, Lj. Radulović, M. Debeljević, S. Peruničić, Z. Idrizović, J. Eraković, D. Milikić, I. Bulatović - Analitical Concordance Between KFLC Index And Isoelectric Focusing of Cereborspinal Fluid and Serum In Patients With Multiple Sclerosis: Experience From Montenegro

PO2-12 – M. Kandić, B. D. Vratnica, D. Đurović - The effect of potato pretreatment on acrylamide formation in French fries during frying

PO2-13 – M. Kaluđerović, M. Bigović, J. Micev, A. Rakočević - Development and Environmental Biodegradation of Starch-Based Bioplastics

PO2-14 – A. Babić, V. Živković, M. Nikolić, B. Knežević, M. Bigović- Occurrence and distribution of estrogenic compounds in the Skadar Lake basin

PO2-15 – M. Milić, B. Dojčinović, Ž. Jaćimović, S. Novaković, M. S. Novaković, B. Antić - Mechanistic insight into arsenic binding and selectivity of UiO-66-NH_2 in real groundwater

PO2-16 – N. Agilee, M. Delić, Đ. Ogizović, T. Spasojević, N. Prlainović, M. Đolić - From Nut Shell Waste to Dye Adsorbents: The Effect of Cationic Dye Structure on Removal Efficacy

PO2-17 – N. Bošković, A. Race, I. Jerman, Ž. Jaćimović - Anthropogenic Pressure Reflected in Microplastic Loads: Evidence from the Sitnica River

PO2-18 – N. Bošković, Ž. Jaćimović, A. Race, I. Jerman - Hidden Pollutants in a Protected Alpine Environment: Microplastic Contamination of Vražje Lake, Durmitor National Park

PO2-19 – N. Kićović, J. Trifković, F. Andrić, M. Bigović, D. Dabić, M. Kaluđerović, P. Ristivojević - Green NADES-based extraction of apple peel bioactives: a sustainable source of antioxidants and tyrosinase inhibitors

PO2-20 – S. Blagojević, S. B. Vuksanović, J. Jočić, N. Blagojević, V. V. Pešić - Antioxidant Capacity of fresh chokeberry fruit (*Aronia melanocarpa*) from Montenegro

PO2-21 – S. Blagojević, S. B. Vukanović, J. Jočić, V. V. Pešić, N. Blagojević - Spectrophotometric determination of polyphenols in extracts of chokeberry fruit (Aronia melanocarpa) from Montenegro

PO2-22 – S. Lukovac, N. Tadić, D. Đurović, I. Nikolić - Incorporation of flotation tailing from mining of Pb and Zn into fly ash-based geopolymers: Evaluation of the leaching protocol

PO2-23 – T. Vojinović, S. Pantović, M. Delević, Dj. Hadzibeti, M. Roganović - Mercury in Fish and Seafood on the Montenegrin Market: Analytical Monitoring and Relevance for Public Health and Tourism

PO2-24 – T. Milivojević, F. Bošković, B. Mugoša, O. Gogić, M. Nikočević - Assessment of Acrylamide Exposure and Associated Health Risk from Potato Chips Consumption in Montenegro

PO2-25 – D. Vuksanović, D. Radonjić, J. Šćepanović - The role of Transfer stations in an efficient Waste management system

Plenary Lectures

Franc Perdih

University of Ljubljana, Slovenia

Dr. Franc Perdih is a professor at University of Ljubljana, where he serves as Vice-dean of Faculty of Chemistry and Chemical Technology. Prof. Perdih is member of Slovenian Chemical Society where he serves as a general committee member as well as Editor-in-Chief of Acta Chimica Slovenica. He is also Academic Editor and member of Editorial Boards of Bioinorganic Chemistry and Applications, Journal of Chemistry and Macedonian Journal of Chemistry and Chemical Engineering, and member of Editorial Boards of Symmetry and Compounds. He is also a member of Consultancy Subject Group for Chemistry at National Education Institute Slovenia (agency under Ministry of Education, Science and Sport), terminological advisor for chemistry for Dictionary of Standard Slovenian at Fran Ramovš Institute of the Slovenian Language, advisor for chemistry for New Slovenian Biographical Lexicon at Institute of Cultural History. He previously served as Chair of the National Subject Testing Committee for the Matura of Chemistry and member of Curicular Subject Committee for Chemistry at National Education Institute Slovenia. His research interests are synthesis and antidiabetic properties of vanadium and zinc compounds in connection with solid-state and solution-state structures, crystallography, supramolecular chemistry and crystal architecture with a focus to the influence of weak non-covalent interactions.

Lecture:

Zinc and vanadium coordination compounds as potential antidiabetic agents

Franc Perdih

Faculty of Chemistry and Chemical Technology

University of Ljubljana

Ljubljana, Slovenia

Zinc and vanadium coordination compounds as potential antidiabetic agents

Franc Perdih

Faculty of Chemistry and Chemical Technology, University of Ljubljana, Ljubljana, Slovenia,
e-mail: franc.perdih@fkkt.uni-lj.si

Abstract:

One of the most widespread lifestyle-related diseases in the 21st century is thought to be the diabetes mellitus (DM). The worldwide number of patients suffering from DM was estimated to be 589 million in 2024 representing ~11.1% of the adult population and is expected to increase to 853 million by 2045. DM is generally classified into Type 1 DM that is caused by an absolute lack of insulin secretion and Type 2 DM that is characterized by insulin resistance and abnormal insulin secretion. There is an active search for alternatives, especially for cases of type 2, which represents the majority of diabetic patients (~90%). The most common treatment for DM is insulin and also the oral hypoglycaemic drugs are used, however, they are often associated with undesirable side effects or a drop in efficacy after prolonged use. Thus, the development of novel orally active compounds as an alternative for insulin injections as well as for the existing antidiabetics is still required. Zinc and vanadium-containing compounds have proven insulin-like anti-diabetic effects both *in vivo* and *in vitro* [1]. As part of our ongoing research VO^{2+}, VO_2^+ and Zn^{2+} complexes were prepared [2]. New class of picolinato derivatives with substituents at position 6 possessing amine or amide moieties were designed as organic carrier ligands by selective derivatization and metal complexes were prepared. The influence of decorated picolinato organic ligands on the structural characteristics of metal complexes were determined using single crystal X-ray diffraction.

Keywords: diabetes mellitus, vanadium, zinc, coordination compounds, XRD

References: [1] a) K. D. Mjos, C. Orvig, Chem. Rev. 2014, 114, 4540; b) J. Costa Pessoa, S. Etcheverry, D. Gambino, Coord. Chem. Rev. 2015, 301-302, 24; c) K. H. Thompson, J. Lichter, C. LeBel, M. C. Scaife, J. H. McNeill, C. Orvig, J. Inorg. Biochem. 2009, 103, 554.

[2] a) T. Koleša-Dobravc, E. Lodyga-Chruscinska, M. Symonowicz, D. Sanna, A. Meden, F. Perdih, E. Garribba, Inorg. Chem. 2014, 53, 7960; b) T. Koleša-Dobravc, K. Maejima, Y. Yoshikawa, A. Meden, H. Yasui, F. Perdih, New J. Chem. 2017, 41, 735; 2018, 42, 3619; c) D. Sanna, J. Palomba, G. Lubinu, P. Buglyó, S. Nagy, F. Perdih, E. Garribba, J. Med. Chem. 2019, 62, 654; d) D. Sanna, P. Buglyó, S. Nagy, F. Perdih, J. Palomba, V. Ugone, E. Garribba, Polyhedron 2022, 212, 115590.

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Atifa Ajanović

University of Sarajevo, Vetarinary faculty,Sarajevo, BiH

Dr. Ajanović holds a PhD in Chemical Sciences, serves as the Head of the Department of Chemistry, Biochemistry, and Physiology, and is the Deputy Program Director of the Biomedicine program at the Faculty of Veterinary Medicine, University of Sarajevo, Bosnia and Herzegovina. She is also a member of the Chemical Society of Bosnia and Herzegovina. Dr. Atifa Ajanović is a full professor at the University of Sarajevo, Veterinary Faculty, Department of Basic Sciences of Veterinary Medicine. Her teaching responsibilities include undergraduate courses Veterinary Biochemistry I and Veterinary Biochemistry II. Additionally, she is a full professor on the PhD course Biochemistry of Macromolecules and she participates in teaching the PhD courses "Regulation of Life Processes and Functions" and "Laboratory Diagnostics of Diseases in Dogs and Cats" within the Veterinary Medicine and Public Health doctoral program at the Faculty of Veterinary Medicine, University of Sarajevo.

Throughout her career, Prof. Ajanović has focused her research on several scientific fields, including Natural Sciences, specifically Chemical Sciences (Organic Chemistry and Biochemistry) and Veterinary Sciences, particularly in the area of Clinical Sciences. The majority of her research focuses on biochemistry applicable to veterinary medicine, aiming to improve diagnostic methods, reproductive performance, and economic outcomes in livestock breeding. Prof. Ajanović's research group has also conducted assessments of biochemical and hematological parameters of the Bosnian indigenous animal resource with the aim of protecting animal health and preserving the breed. Her most recent work includes exploring diagnostic possibilities for hip dysplasia in the Tornjak breed using protein markers.

Lecture:

Upotreba proteinskih markera u procjeni displazije kukova kod tornjaka

(Application of protein markers in the evaluation of hip dysplasia in Tornjak breed)

Atifa Ajanovic and Ivona Alilovic

Department of Basic sciences of veterinary medicine

University of Sarajevo - Veterinary faculty

Sarajevo, BiH

Abstract

Protein Markers in the Assessment of Hip Dysplasia in the Tornjak Dog Breed

Atifa Ajanovic[1], Ivona Alilovic[2]

[1]University of Sarajevo-Veterinary faculty, Sarajevo, Bosnia and Herzegovina,
atifa.ajanovic@vfs.unsa.ba
[2] University of Sarajevo-Veterinary faculty, Sarajevo, Bosnia and Herzegovina

Abstract:

Hip dysplasia (HD) is a hereditary orthopedic disorder in dogs and represents a health concern in large breeds. Control programs rely on radiographic screening and phenotypic scoring of hip joints in breeding dogs. Their effectiveness remains limited due to the multifactorial nature of the disease and the late age at which reliable radiographic diagnosis can be established. Since dogs reach sexual maturity before the recommended diagnostic age, affected animals may be bred and transmit the disease. Consequently, there is a growing need for earlier diagnostic approaches. Recent studies highlight protein markers related to cartilage metabolism and joint inflammation as promising diagnostic tools for orthopedic diseases. The Tornjak, an autochthonous livestock dog from BiH recognized by the FCI in 2017, is a large breed predisposed to HD and suitable for marker research. Research in canine populations has significant translational value for human medicine. Dogs serve as important models for studying joint degeneration and osteoarthritis due to similarities across species. Radiographic examination of hip joints was performed according to the FCI-recommendation. Dogs were classified into dysplastic and non-dysplastic groups based on radiographic findings. Serum concentrations and enzymatic activity of selected protein biomarkers, procollagen II C-terminal propeptide (PIICP), matrix metalloproteinase 9 (MMP9), and hyaluronic acid (HA) were determined using spectrophotometric methods with commercial ELISA kits. Statistical analyses revealed significant differences between the two groups. Logistic regression analysis indicated a significant association between low levels of HA, high activity of MMP9 and the presence of HD. ROC analysis demonstrated strong predictive potential of the investigated biomarkers, with threshold values of HA ≤ 288, MMP9 >0.779, and PIICP >31.625 indicating HD with high sensitivity and specificity. These findings highlight the potential of protein markers for early assessment of HD and developing diagnostic panels for HD, simultaneously supporting the health and sustainability of the Tornjak breed.

Keywords:

Protein marker, Hip dysplasia, Tornjak breed, Early diagnosis

Vladimir P. Beškoski

University of Belgrade – Faculty of Chemistry

Dr. Vladimir P. Beškoski, PhD in Biochemistry, completed his PhD at the University of Belgrade – Faculty of Chemistry (UBFC) in 2011. His thesis focused on the activities of microorganisms in soil contaminated by crude oil and their application in bioremediation across laboratory, pilot, and industrial scales. As an Invited Foreign Researcher supported by the Japan Society for the Promotion of Science (JSPS), he spent over two years within the last decade at Kobe University, Japan, specializing in the biodegradation of persistent organic pollutants, particularly per- and polyfluoroalkyl substances (PFAS). Since 2012, he has held academic positions at UBFC, starting as an assistant professor, progressing to associate professor, and being elected as a full professor in 2022. He currently serves as the President of the Environmental Chemistry Division of the Serbian Chemical Society and as the National Representative in the International Union of Pure and Applied Chemistry (IUPAC), Division VI: Chemistry and the Environment. He has coordinated and served as Principal Investigator on more than ten major international and national initiatives, funded by Horizon Europe (European Commission), Science Fund of Serbia, Innovation Fund of Serbia, Solvay Specialty Polymers Italy S.p.A. and multiple projects funded by Japan International Cooperation Agency (JICA). His scholarly output includes authoring over 80 papers in peer-reviewed journals and 3 book chapters, with more than 1500 citations and an h-index of 22 according to the Scopus database. He was associate editor of the Journal of Serbian Chemical Society and is associate editor in the Environmental Monitoring & Contaminants Research journal. Dr. Beškoski research spans several facets of environmental biotechnology and microbial ecology, including the application of green chemistry principles using microbial processes, microbial activities and their applications in biogeotechnology, bioremediation, and agriculture. He also focuses on microbial consortium dynamics, changes in microbial diversity during bioremediation, the genetic and biochemical basis of bacterial degradation of oil hydrocarbons and persistent organic pollutants, and the application of products of microbial metabolism, such as exopolysaccharides and rhamnolipids. He served as a mentor for 100 BSc, more than 40 MSc thesis and 8 PhD dissertations, finished under his supervision.

Title of the lecture:

PFAS: Historical Context, Current Challenges, and Future Directions

PFAS: Historical Context, Current Challenges, and Future Directions

Vladimir P. Beškoski

University of Belgrade - Faculty of Chemistry, Serbia, vbeskoski@chem.bg.ac.rs

Since the 1940s, per- and polyfluoroalkyl substances (PFAS) have been widely produced and used in numerous industrial and consumer applications due to their exceptional chemical stability, thermal resistance, and surface-active properties. Their strong carbon-fluorine (C-F) bonds make them highly persistent in the environment, leading to their global distribution in water, soils, sediments, biota, and human body. Depending on chain length and functional groups, PFAS exhibit varying mobility and sorption behavior. Growing scientific evidence has led to intensified regulatory action worldwide. PFOA, PFOS, PFHxS, PFOSF and related compounds are now listed under the Stockholm Convention, and broad restrictions are being proposed in the European Union and worldwide. The scale of the problem is not only environmental and toxicological, but profoundly economic. According to the European Commission's assessment and considering health impacts from only four well-studied PFAS (PFOA, PFOS, PFHxS and PFNA), the cumulative present value of quantifiable societal costs across the assessment period (2024-2050) reaches approximately €440 billion. Current remediation approaches include physicochemical and biological strategies. Abiotic techniques such as immobilization with sorbents, soil washing, thermal treatment, mechanochemical destruction, and advanced oxidation/reduction processes can reduce PFAS mobility or achieve partial to high destruction efficiencies, although they are often energy-intensive or limited by soil characteristics. Biotic approaches, including phytoremediation and microbial remediation, offer cost-effective and environmentally compatible alternatives. Plants can uptake and accumulate certain PFAS, while specific microbial consortia have demonstrated partial defluorination and transformation under controlled conditions. However, complete mineralization pathways remain insufficiently understood and still unrecognized. Future solutions will require integrated remediation strategies that combine capture and destruction technologies with biologically assisted processes, supported by advanced analytical tools to confirm complete mineralization. Coupled with regulatory measures and the development of safer chemical alternatives, such approaches are essential to address the long-term environmental and health challenges posed by PFAS.

Keywords: PFAS, History, Societal costs, (Bio)remediation, Future solutions.

Fehim Korać

University of Sarajevo. B&H

Dr. Fehim Korać is a professor at the Faculty of Science of the University of Sarajevo. He works at the Department of Physical Chemistry and is a member of the Society of Chemists and Technologists of Sarajevo Canton. He has participated in organizing congresses within the Society.

Dr. Korać is the Editor-in-Chief of the Bulletin of Chemists and Technologists of Bosnia and Herzegovina.

He earned his PhD in Chemistry from the University of Sarajevo.

His work focuses on corrosion and protection. His research interests include the corrosion of orthopedic implants and the interaction of materials with biological systems. In addition, he studies the practical application of environmentally friendly corrosion inhibitors.

Recently, he has been increasingly involved in environmental issues. He served on commissions responsible for issuing environmental permits to large companies in Bosnia and Herzegovina. He is currently working on solving corrosion problems in hot water piping systems.

Lecture:

"Characteristics of Materials Used in the Manufacture of Orthopedic Implants and Their Impact on the Human Body”

Fehim Korać, Selma Burović, Selma Korać

Department of Physical Chemistry, University of Sarajevo

Characteristics of materials for the manufacture of orthopedic implants and their impact on the human body

Fehim Korać*[1], Selma Burović[2], Selma Korać[3]

[1]Faculty of Science, University of Sarajevo, B&H, e-mail: fkorac@pmf.unsa.ba
[2] Sarajevo School of Science and Technology, B&H
[3]Faculty of pharmacy , University of Sarajevo, B&H

Abstract:

Biomaterials in the form of implants and medical devices are very often used to replace and/or restore the function of damaged or degenerated tissues or organs. They must have the appropriate characteristics, even when working in a very difficult environment, such as the human body.

When installing an implant, two conditions must be met: the biocompatibility of the material and the mechanism of complete integration of the inorganic material with human tissues. Due to its durability, proven biocompatibility, titanium and its alloys are by far the best and most commonly used materials today.

Biocompatibility of both permanent and temporary implants is a significant concern, and the negative biological effects of certain metal components of stainless steel must be known. In vitro studies of stainless steel are usually performed in a saline environment and aim to simulate physiological conditions. The human body is a complex environment that contains not only passivating and aggressive agents but also species that act as complexing agents.

Most internal fixation devices remain in the body after the fracture has healed, but often cause discomfort and require removal. Polylactic acid and polyglycolic acid have been used as biodegradable polymers to treat minimally loaded fractures, thus eliminating the need for a second surgery to remove the implant. Among the many technological applications, stainless steel type 316 L is used for medical purposes.

Sarafix is a very simple external fixator and is used to fix fracture segments. It is used in war conditions because it provides access to multiple injuries without major complications.

The corrosion properties of biomaterials meet the requirements for use. The electrochemical properties were investigated in vitro, by cyclic voltammetry and Tafel extrapolation. The results showed extremely good results and it was proven that they do not pose a risk to human health.

Keywords:

Biomaterial, implant, biocompatibility, corrosion

Mirjana M. Radanović

University of Novi Sad Faculty of Sciences, Novi Sad, Serbia

Dr. Mirjana M. Radanović obtained her PhD in Chemistry at the University of Novi Sad Faculty of Sciences, where she currently holds the position of an associate professor. She is a member of the Presidency of the Serbian Crystallographic Society, a Fellow of the Serbian Chemical Society, and a member of the European Crystallographic Association.

The focus of her research is the synthesis and physicochemical characterization of transition metal complexes with biologically relevant Schiff bases, with a particular emphasis on the structural analysis of the resulting compounds. Currently, the group is interested in co-crystal formation, polymorphism, DFT calculations, and utilizing the Cambridge Structural Database to extract chemical knowledge. Another goal is the investigation of the optical properties and the potential application of synthesized complexes as OLED materials and the materials of potential use in solar cells and smart windows.

M. Radanović has co-authored 37 scientific papers (h index 10) in international journals and numerous communications presented at international and domestic conferences and meetings. She is an active reviewer for many international journals, and has been a guest editor for two so far. She was the PI of one provincial project dealing with the potential use of coordination polymers for carbon capture. Also, she was the mentor of 14 BSc and 5 MSc theses, and is currently working with students on their PhD, MSc, and BSc theses.

Lecture:

Expanding the Functional Landscape of Metal Complexes: From Concept to Application

Expanding the Functional Landscape of Metal Complexes: From Concept to Application

Mirjana M. Radanović[1]

[1]Universtity of Novi Sad Faculty of Sciences, Novi Sad, Serbia e-mail: mirjana.lalovic@dh.uns.ac.rs

Abstract:

The field of metal complex application is versatile. However, these compounds are predominantly designed, synthesized, and investigated for medical and pharmaceutical purposes. Apart from this noble cause, one of many other paths to explore is presented here. Having in mind the necessity of advances in renewable energy, as well as stability, cost and recyclability issues of metal complexes currently used in solar technologies, new strategies are necessary. This research focuses on complexes of 3d and 4d metals as proper and easily available dyes for dye-sensitized solar cells and photoelectrochromic devices. The ligands with C=N bonds are photoactive and enhance the photophysical properties of the complexes. To date, more than 100 metal complexes have been successfully synthesized, and synthetic procedure have been adjusted to obtain single-crystals and enable complete structural characterization. Various classes of ligands were used, i.e. Schiff bases of aminoguanidine, tetraimine derivatives of 2,6-diacetylpyridine, and pyrazole derivatives. Different donor sets, denticity of the ligands, and coordination environment of metal ions determine the differences in properties of the obtained complexes. Based on their detailed comparative structural analysis, the results of infrared spectroscopic, conductometric, and photoluminescence measurements, and the examination of their stability under different types of radiation and toward heat, the best candidates are selected for the further research. Also, based on these results, changes are made for the synthetic procedures in order to obtained complexes with enhanced properties. This will lead to proper procedures for the synthesis of stable dye complexes to be tested in a prototype of dye-sensitized solar cells and photoelectrochromic devices.

Keywords:

Shiff base, pyrazoles, ligands, coordination, structural analysis

Session Lectures

Jane Bogdanov

Dr. Jane Bogdanov, Full Professor of Chemistry, was born on April 24, 1974 in Skopje, R. Macedonia (SFR Yugoslavia). He completed his secondary education in Skopje and in the USA (Marie Curie-Sklodowska, specialized Chemical High-school, fourth year, Leslie County, Hayden, Kentucky). In the academic year 1992/93, he enrolled in chemistry studies at the University of Kentucky, USA. He graduated in 1996 with a GPA of 3.82/4.00.

He completed his undergraduate thesis entitled "Removal of aryl halides from aqueous solutions with high-energy radiation" under the supervision of Prof. Dr. Robert Guthrie. After graduation, he was accepted for PhD studies at Pennsylvania State University (PSU), USA, where he was a teaching assistant from 1996 to 2001 and received the Dan Waugh Memorial Award as the best assistant in 1999. From 2001 to 2005 he was research assistant of organic chemistry at Pennsylvania State University. In December 2004 he defended his doctoral dissertation in the field of physical-organic chemistry, under "Electron delocalization in spiroconjugated systems". (The mentor of the thesis was Prof. Dr. Przemyslaw Maslak).

From the defense of his doctoral thesis until September 2005, Dr. Jane Bogdanov was a postdoctoral fellow at the same faculty and worked on the scientific research project entitled "Electron delocalization in systems with increased dimensionality". In the summer semester of the 2004/2005 academic year, he was a lecturer at the PSU of the course Fundamentals of organic chemistry.

In September 2009, he was appointed as Assistant Professor of chemistry at the Institute of Chemistry at the Faculty of Natural Sciences and Mathematics (FNSM), Ss. Cyril and Methodius University in Skopje, R. Macedonia. In October 2014 he was promoted to Associate Professor of chemistry and in July 2019 he became Professor of Chemistry at the FNSM, Ss. Cyril and Methodius University in Skopje.

Throughout his academic career he was involved in teaching organic chemistry and laboratory courses: Organic chemistry I and II, Experimental organic chemistry, Chemistry of natural products and Analysis of petroleum derivatives and fuels. Prof. Bogdanov, has actively been involved in the preparation and modernization of the new curricula and programs for the first, second and third cycles and has introduced several modern subjects in the field of organic chemistry.

To date, he has been a mentor in the preparation of 45 undergraduate diploma theses, 16 Master's degree students, 3 doctoral students, as well as a member of several committees for academic promotions. He was the Principal investigator of 4 scientific research projects and a participant in 16 projects. He published 51 papers in journals, presented over 50 papers at scientific meetings and reviewed over 50 papers in domestic and international journals. He is the author of three books and was one of the translators of one practicum and two books.

From applicative point of view, Dr. Bogdanov is actively involved in the international collaboration, in improving the research and application capacity of the Institute of Chemistry, as well as in promoting the University and establishing and maintaining contacts with the domestic industrial sector. As of 2016, he is the Head of the Research Laboratory for Analysis of Petroleum Derivatives and Fuels, from 2014 a member of the Standardization Institute of R. Macedonia (Plastics and chemistry section), and since 2016 he has been a member of the Executive Board of the Society of Chemists and Technologists of Macedonia responsible for international cooperation.

MONOCARBONYL ANALOGS OF CURCUMIN (MACs): VERSATILE AND READILY ACCESSIBLE ORGANIC COMPOUNDS WITH DIVERSE BIOLOGICAL ACTIVITIES

Jane Bogdanov[1]

[1]Institute of Chemistry, Faculty of Natural Sciences and Mathemetics, Ss. Cyril and Methodius University, 1000 Skopje, R. N. Macedonia, e-mail: j_b_bogdanov@yahoo.com

Abstract:

The bioavailability of the natural product curcumin can be improved by replacing its β-diketo moiety with a single carbonyl group. The resulting derivatives, known as monocarbonyl analogs of curcumin (MACs), have been reported to exhibit a wide range of biological activities. Their key pharmacophore consists of a 1,5-diaryl-3-oxo-1,4-pentadienyl system containing two arylidene groups conjugated with a keto group. In the present study, symmetrical diarylidenylcycloalkanones were selected because of their straightforward synthesis, relatively rigid structure, and previously demonstrated biological activity. The α,β-unsaturated keto group in these compounds acts as a *thia*-Michael acceptor, reacting preferentially with biologically relevant thiols rather than amino or hydroxyl groups. As a result, these systems are expected to show lower mutagenic potential compared with certain alkylating therapeutic agents. In addition, these bifunctional Michael acceptors may undergo successive reactions with cellular thiols. Several derivatives were synthesized in high yields through a simple crossed aldol condensation between cyclohexanone and substituted benzaldehydes under basic conditions. The resulting MACs were obtained in high purity, typically after recrystallization from appropriate solvents such as ethanol, methanol, methanol/CH_2Cl_2 mixtures, or ethyl acetate. Two compounds, (2*E*,6*E*)-2,6-bis[(2-(trifluoromethyl)benzylidene]cyclohexanone and (2*E*,6*E*)-2,6-bis(2-bromobenzylidene)-cyclohexanone, were further evaluated *in vivo* for antioxidant activity in a mouse model of isoproterenol-induced cardiac damage. In addition, computational studies were carried out to examine their electronic properties, including atomic charges within the α,β-unsaturated system, torsional angles of the aryl groups, and the energies of the frontier molecular orbitals (HOMO and LUMO). These results may serve as a useful guide for the design of new compounds with potential antioxidant, anti-inflammatory, and other biologically relevant activities.

Keywords: Curcumin, Monocarbonyl analogs of curcumin (MACs), α,β-unsaturated ketones

Miljan Bigović

Miljan Bigović is professor of organic chemistry at the University of Monetengro, Faculty of Natural Sciences and Mathematics. He graduated in Chemistry in 2008 at the University of Belgrade, Faculty of Chemistry. In 2015 he received PhD in the field of organic synthesis at the University of Belgrade, Faculty of Chemistry. In 2012, he joined the University of Montenegro first as a teaching assistant and since 2016 as an assistant professor. Today he is an associate professor and also the dean of the Faculty of Science and Mathematics. His fields of scientific interest are organic chemistry, organic synthesis, organometallic chemistry and environmental chemistry. His current research findings have been published in more then 50 scientific papers in international journals with impact factor. He is the leader and member of a number of national and international scientific projects. He was involved in the development of new curricula, preparation of study materials, and was also the chairman of the committee for the preparation of the detailed report for the Chemistry study program. In addition to scientific and pedagogical work, he is also involved in the promotion of science among elementary and secondary school students, and in this sense he cooperates with several organizations that promote science. He is the winner of the Oktoih State Award for 2024 - an award for exceptional results in the field of education. He is a member of the Serbian Chemical Society and a Montenegrin Society of Chemists.

Synthesis of new Schiff bases with thiocarbohydrazide and optimization of reaction conditions

Miljan Bigović[1]

[1] Faculty for Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro,
e-mail:miljan@ucg.ac.me

Abstract:

Ultraviolet (UV) radiation from sunlight poses significant risk to biological systems, notably causing skin cell damage, premature ageing, and diseases ranging from inflammation to cancer. To mitigate these effects, UV filters are widely used incorporated into personal care products such as sunscreens, lipsticks, shampoos, and hair spray. These products are especially prevalent in environments with high UV exposure, including swimming pools, coastal areas, snowy regions, and mountains. However, studies have shown that UV filters can degrade through oxidation or photoreaction. In this lecture we will present results of the study, investigation the transformation of selected UV filters and antioxidants found in sunscreens under disinfection conditions. A range of experimental setups were employed, varying media types, light sources, ion concentrations, disinfectants, and their combinations to simulate realistic environmental conditions. Transformation products were identified using HPLC-MS and GC-MS, with some compounds synthesized independently to confirm their structure. More than 60 disinfection by-products (DBPs) were identified as transformation products of avobenzone during chlorination and bromination in both freshwater and seawater. The formation of halogenated by-products is inevitable due to the presence of reactive moieties such as double bonds, phenolic groups, ketones, and amines. Notable DBPs include chloroanhydrides and chlorophenols, and brominated phenols and substituted acetophenones. The mechanisms of aquatic chlorination and bromination are complex and difficult to predict. The diversity and concentration of DBPs depend on multiple factors: disinfectant type and concentration, substrate-chlorine ration, pH, temperature, reaction time, and water composition. These parameters significantly influence the toxicity of the resulting mixtures.

Keywords:

Schiff-base, thiocarbohydrazone, DBPs, organic synthesis

Ivan Nemet

Faculty of Science, Zagreb, Croatia

Dr. Ivan Nemet, is an Assistant Professor at the University of Zagreb, Faculty of Science, Department of Chemistry. He earned his PhD in 2018 from the same institution, specializing in analytical chemistry with a focus on atomic spectrometry. Dr. Nemet has authored and co-authored over 30 scientific and professional publications, and has presented his work at numerous national and international conferences. His research is primarily focused on the development and application of atomic spectrometric techniques using plasma sources, essential for trace element analysis across various industries. He teaches analytical chemistry at both undergraduate and graduate levels, combining a strong theoretical foundation with hands-on laboratory experience, aiming to prepare students for both academic and industry careers. In addition to his academic work, he is actively involved in applied analytical projects, notably through the project "Analyses", which provides expert services to external clients in pharmaceuticals, metallurgy, processing industries, and geological research. He is also committed to science outreach and education, regularly organizing and leading workshops and lectures for the public during events such as Day and Night at the Faculty of Science and the University of Zagreb Fair, with the goal of promoting chemistry to students and the broader community. Since 2013, he has served as a member of the National Committee for the Chemistry Competition and is involved in training high school students for the International Chemistry Olympiad (IChO). He has been an active member of the Croatian Chemical Society since 2008, contributing to the advancement of chemistry education and research in Croatia. In recent work, Ivan Nemet has been engaged in the synthesis and functionalization of iron nanomaterials, as well as in conducting sorption experiments to investigate their physicochemical properties. His research integrates advanced analytical techniques, such as ICP-MS and LA-ICP-MS, to conduct high-precision elemental analysis.

Lecture:

Nano-Iron Power: A Cutting-Edge Solution for Heavy Metal Removal from Water

Assistant Professor

Division of Analytical Chemistry

Department of Chemistry

University of Zagreb

Abstract

Nano-Iron Power: A Cutting-Edge Solution for Heavy Metal Removal from Water

Ivan Nemet[1]

[1] Department of Chemistry, Faculty of Science, University of Zagreb, Zagreb, Croatia, e-mail:
inemet@chem.pmf.hr

Abstract:

Human activities frequently release heavy metals, including rare earth elements, into natural water systems. To protect water resources and aquatic ecosystems, the removal or immobilization of these metals is essential. Nanoscale zero-valent iron (nZVI) has emerged as a promising material for water remediation due to its high specific surface area, strong reducing potential, and adaptable surface chemistry.[1] nZVI particles typically exhibit a core–shell structure consisting of a metallic Fe^0 core surrounded by a layer of iron oxides or hydroxides. This structure enables several removal pathways, including reductive transformation of metal ions, adsorption onto iron oxide surfaces, and coprecipitation with iron corrosion products. Research conducted within our research group focuses on the development and characterization of nZVI-based systems for the removal of metal ions from aqueous solutions. Both non-functionalized and surface-functionalized nanoparticles have been investigated. Surface functionalization enhances sorption capacity and introduces selectivity toward specific metal ions. Experimental observations indicate that metal removal by bare nZVI occurs through combined sorption, reduction, and precipitation processes driven by the highly reactive Fe^0 core and the formation of iron oxide surface layers. Surface functionalization modifies these mechanisms by promoting adsorption and complexation, with ligand-specific interactions influencing metal affinity. The formation of iron oxide phases such as magnetite and feroxyhyte affects nanoparticle reactivity and stability, while PDCA-modified nanoparticles showed ellipsoidal particle elongation, suggesting that ligand chemistry may influence nanoparticle morphology.[2] Future research within our group will include the application of advanced analytical techniques such as Single-Particle Inductively Coupled Plasma Mass Spectrometry and Laser Ablation Inductively Coupled Plasma Mass Spectrometry to obtain deeper insight into nanoparticle transformations, size distribution, and spatial distribution of accumulated metals in nanoparticle-based remediation systems.

Keywords: Iron nanoparticles, encapsulation, sorption, ICP-MS

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2. S. Rončević, I. Nemet, V. Zagorec, A. Selmani, New J. Chem. 44 (2020) 17840–17848.

Ivan Jerman

Assoc. Prof. Dr. Ivan Jerman is a senior researcher at the National Institute of Chemistry in Ljubljana and the head of the Coating development lab. He graduated from the University of Ljubljana, Faculty of Education, in 2005 and received a Ph.D. from the University of Ljubljana, Faculty of Chemistry and Chemical Technology, in 2009. His research interest is synthesis of polyhedral oligomeric silsesquioxane, sol-gel thin films, spectrally selective coatings, finishing textiles, surface treatments, electrochromic materials, perovskite solar cells, flame retardant materials, and IR and Raman spectroscopy. He has authored and co-authored more than 144 peer-reviewed scientific articles in global journals, receiving over 2880 citations. Furthermore, he has authored co-authored nine patents, two of which have been sold to the German industry (https://www.webofscience .com/wos/author/record/AAE-2628-2019). Prof. Jerman received two innovation awards in 2009, including the Puh Award for his inventions: “The use of nanocomposites for making paints for spectral selective coatings for solar collectors”.

Industrial Decarbonization by Concentrating Solar Power Plants – Absorber Coatings

Ivan Jerman

[1]National Institute of Chemistry, Ljubljana, Slovenia, ivan.jerman@ki.si

Abstract:

Concentrated solar power (CSP) by tower technology is projected to provide electricity at rates below 7 cents per kilowatt-hour, utilizing thermal energy storage and forthcoming renewable energy harvesting technologies. Nonetheless, the cost is significantly influenced by the efficiency of solar to thermal energy transformation. Past research on absorber coatings indicated a decline in absorber efficiency over time. Nevertheless, the intense thermal and environmental stresses during CSP operation are anticipated to result in premature failure. The service life of the absorber coating, as shown by the energy-transformation efficiency relative to running time, is directly proportional to the anticipated profit for investors.

This lecture presents the development of high solar absorptivity coatings, advanced analytics, theoretical modelling, and industrial collaboration. A cutting-edge industrial coating using a black spinel pigment integrated into a silica matrix can endure for over 10 years, exhibiting a solar absorptance above 95%. We established the correlation between the coating's performance and its anticipated longevity using advanced material characterization, providing comprehensive insights into long-term stability and degradation mechanisms under simulated operational settings.

Keywords:

Solar energy, Concentrated Solar Power, Absorber coatings,

Polonca Trebše

University of Ljubljana, Ljubljana, Slovenia

Polonca Trebše is professor of chemistry at the University of Ljubljana, Faculty of Health Sciences. She graduated in Chemistry in 1990 at the University of Ljubljana, Faculty of Chemistry and Chemical Technology, then she obtained her master’s degree 1994 in the field of organic synthesis of heterocyclic compounds, and in 1997 received her PhD in the field of organic synthesis, all at the University of Ljubljana, Faculty of Chemistry and Chemical Technology. In 1997, she joined the University of Nova Gorica (former Faculty of Environmental Sciences), where she was employed until 2013 when she has got the position at University of Ljubljana, Faculty of Health Sciences.

Her research and expert area include studies on photochemical degradation and transport of different organic pollutants, mainly pesticides in the aquatic environment; study of transformation and identification of different pollutants (UV filters, THMs) under disinfection conditions; and organic pollutants instrumental analysis.

Her current research findings have been published in more then 100 scientific papers in international journals with impact factor. She is experienced with the management of national and international research projects, she was involved in the development of new curricula, preparation of study materials, and staff training on the academic level.

For her research work she got several awards: Krka award for years 1995 and 1997, Zois award (national scientific award) for important achievements on the field of chemistry and ecotoxicology in 2008, and Prometheus of Science for Excellence in Communication in 2020.

She is a member of the Slovenian Chemical Society (since 1990) and a member of the European Association of Chemistry and the Environment (since 2010).

Lecture:

The Hidden Chemistry of a Swim: What’s in the Water?

Polonca Trebše

Faculty of Health Sciences

University of Ljubljana

Ljubljana, Slovenia

The Hidden Chemistry of a Swim: What's in the Water?

Polonca Trebše[1]

[1] Faculty of Health Sciences, University of Ljubljana, Ljubljana, Slovenia, e-mail: polonca.trebse@zf.uni-lj.si

Abstract:

Ultraviolet (UV) radiation from sunlight poses significant risk to biological systems, notably causing skin cell damage, premature ageing, and diseases ranging from inflammation to cancer. To mitigate these effects, UV filters are widely used incorporated into personal care products such as sunscreens, lipsticks, shampoos, and hair spray. These products are especially prevalent in environments with high UV exposure, including swimming pools, coastal areas, snowy regions, and mountains. However, studies have shown that UV filters can degrade through oxidation or photoreaction. In this lecture we will present results of the study, investigation the transformation of selected UV filters and antioxidants found in sunscreens under disinfection conditions. A range of experimental setups were employed, varying media types, light sources, ion concentrations, disinfectants, and their combinations to simulate realistic environmental conditions. Transformation products were identified using HPLC-MS and GC-MS, with some compounds synthesized independently to confirm their structure. More than 60 disinfection by-products (DBPs) were identified as transformation products of avobenzone during chlorination and bromination in both freshwater and seawater. The formation of halogenated by-products is inevitable due to the presence of reactive moieties such as double bonds, phenolic groups, ketones, and amines. Notable DBPs include chloroanhydrides and chlorophenols, and brominated phenols and substituted acetophenones. The mechanisms of aquatic chlorination and bromination are complex and difficult to predict. The diversity and concentration of DBPs depend on multiple factors: disinfectant type and concentration, substrate-chlorine ration, pH, temperature, reaction time, and water composition. These parameters significantly influence the toxicity of the resulting mixtures.

Keywords:

Ultraviolet radiation, Disinfection by-products (DBPs), Avobenzone, HPLC-MS, GC-MS

Branimir Jovančićević

Full Professor Branimir S. JOVANČIĆEVIĆ, PhD in Chemistry

Dr Branimir Jovančićević performed his basic studies in Chemistry at the FCUB. He finished his Magister of Science thesis in 1988 and PhD in 1993. In 2000 and 2002 he finished post doctor study, as Alexander von Humboldt scholar (Federal Institute of Geosciences and Natural Resources, BGR, Hannover, Germany - petroleum organic geochemistry and environmental chemistry). In the last three Serbian Ministry of Science project periods he has been the chief of project in the field of organic geochemistry and environmental chemistry. He has been co-manager of two TEMPUS, one ERASMUS+ and one German government projects, participant of Japanese International Corporation Agency (JICA) project and chief of bilateral projects with Germany and China. Over the last almost 40 years, his research focused on the organic geochemistry (petroleum, oil shale, coal, sediments) and environmental chemistry (organic pollutants, bioremediation). His research involved the supervision a number of students at the BSc, MS, Diploma, and PhD level (23 students with completed doctoral studies). He is/was associate editor of journal Environmental Chemistry Letters (Springer), expert for the evaluation of FP7 projects, President of Humboldt club in Belgrade, dean of FCUB, president of Serbian Ministry of Science committee for geo- and astro-sciences, president of European Association of Chemistry and Environment (ACE). He is author of 7 books (5 by Springer), 7 book chapters, 3 editions. According to Scopus: 135 SCI papers.

Lecture:

Petroleum as a native material in the geological conditions and as anthropogenic material in the environment

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Petroleum as a native material in geological conditions and as anthropogenic material in the environment

Branimir Jovančićević

Unievrsity of Belgrade, Faculty of Chemistry, Serbia, bjovanci@chem.bg.ac.rs

Crude oil (petroleum) is the most important fossil fuel. From a fundamental, organic-geochemical point of view, it is only one form of the organic substance of the geosphere. However, from a commercial point of view, it is the most important material in sedimentary formations. Crude oil is a very complex mixture of organic compounds from which different fractions are obtained through the rectification process as the most important liquid fossil fuels.

This paper will first explain the way oil is formed in natural geological conditions. The most important results of organic geochemical investigations of oils belonging to the southeastern part of the Pannonian basin on the territory of Serbia will be presented. These investigations were carried out with the aim of evaluating the origin of the oil, i.e. the type of precursor biomass, the environment of deposition, the length of the migration path and the degree of changes in the reservoir rocks. For this purpose, the abundance and distribution of biological markers of the *n*-alkane type, isoprenoid aliphatic alkanes and polycyclic alkanes, steranes and terpanes, as bicyclic and tricyclic aromatic compounds of naphthalene and phenanthrene type, and their methyl and polymethyl isomers were used.

On the other hand, oil also contains numerous toxic organic compounds. Therefore, when they reach the environment, they are considered very serious pollutants in all its segments. Pollution of the environment from oil and its derivatives can occur at the oil wells themselves, in collection stations of oil fields, during the transportation of crude oil to the refinery, during processing in refineries, during the transportation of derivatives to consumers, and finally during the actual use of various refinery products.

Therefore, in the second part of the lecture, there will be an explanation of the method for identifying oil pollutants in the environment, the transformations to which it is subject, and some of the most important methods for removing oil pollutants from the environment. Many of these questions can be explained by the same biological markers that are used in organic geochemical studies to study the origin and geological history of oil.

Keywords:

Crude oil, Fossil fuel, Organic geochemistry, Petroleum pollutants, Biological markers

Contributed Abstracts

Oral Session Presentations

ICP-MS Based Study of Lanthanide Ion Sorption onto Iron Nanoparticles Encapsulated in Alginate Hydrogel

Nikolina Ilić[1]

[1] Department of Chemistry, Faculty of Science, University of Zagreb, Zagreb, Croatia, e-mail: nilic@chem.pmf.hr

Abstract:

Rare earth elements (REEs) comprise a group of 17 chemically similar elements that play a crucial role in modern technologies. However, their extensive use and the lack of efficient recycling strategies have contributed to increasing environmental contamination, particularly in aquatic environments.[1] Therefore, developing effective methods for their removal is essential in order to mitigate pollution in water and soil. Recent studies have pointed to iron nanoparticles as innovative material for removing REEs from contaminated environments. Compared with conventional zero-valent iron (ZVI) particles, nanoscale zero-valent iron (nZVI) possesses larger specific surface area and greater reactivity.[2] These properties make nZVI highly effective for eliminating heavy metals and organic pollutants from water. Despite these advantages, practical applications of nanoparticles are often hindered by their tendency to agglomerate. Iron nanoparticles are frequently surface-functionalized or stabilized with various agents to overcome this issue. One approach to improving their stability is encapsulation within alginate hydrogel, which was employed in this study. In this work, iron nanoparticles were synthesized in two forms: neutral and modified with pyridine-2,6-dicarboxylic acid (PDCA) by reduction of iron (III) ions from iron (III) chloride hexahydrate with sodium borohydride. The synthesized nanoparticles were characterized using infrared spectroscopy with the attenuated total reflection (ATR) technique and scanning electron microscopy (SEM). Subsequently, the nanoparticles were encapsulated in calcium alginate hydrogel through a spherification process involving sodium alginate and calcium chloride. Sorption of selected REEs (La^{3+}, Pr^{3+}, Nd^{3+}, Eu^{3+}, Gd^{3+}, Dy^{3+}, Er^{3+}, and Tm^{3+}) onto iron nanoparticles was analyzed using inductively coupled plasma mass spectrometry (ICP-MS). Both neutral and PDCA-modified iron nanoparticles encapsulated in calcium alginate demonstrated very high sorption efficiencies for all examined elements, particularly at low concentrations, where removal efficiencies ranged from 95.0% to 99.8%. Nevertheless, the functionalized nanoparticles showed slightly lower sorption efficiency in the low-concentration range compared with the neutral nanoparticles.

Keywords: Iron nanoparticles, encapsulation, sorption, ICP-MS

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From complex polymer lignin to multifunctional nanoparticles

Jelena Papan Djaniš[1,2]

[1]Faculty of Chemistry and Chemical Technology, University of Ljubljana, 1000 Ljubljana, Slovenia, e-mail: jelena.papandjanis@fkkt.uni-lj.si
[2]Centre of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, 11351 Belgrade, Serbia

Abstract:

Lignin is a natural polymer, one of the main constituents of plant cell walls, and the second most abundant polymer in nature, after cellulose. Its complex polymer structure is rich in aromatic structures, such as three principal building blocks, p-hydroxyphenyl (H), guaiacyl (G), and syringyl (S), and could be a promising carbon precursor. However, the valorization of lignin is limited. Currently, lignin is mostly produced as a by-product of paper and pulp production, and it is mainly valorized through its use as a low-value fuel. Due to its aromatic structure, lignin is a promising candidate for conversion into a wide range of materials, such as lignin carbon quantum dots (LG CQDs), lignin nanomaterials (LNPs), lignin graphene nanosheets, lignin nanodiamonds, and hybrid lignin nanomaterials.[1] Among them, especially interesting are LG CQDs and LNPs. The complex aromatic structure of lignin is an excellent platform for using lignin as a luminescent material, especially after transformation into LG CQDs, where the optical properties of LG CQDs can be tailored with different synthesis parameters.[2] The most used synthesis for such transformation is the hydrothermal route, where LG CQDs are formed through depolymerization, nucleation, growth, and surface passivation. Obtained LG CQDs nanomaterials have enormous application potential as luminescent sensors for pH, temperature, and different contaminant ions, etc. On the other hand, lignin can be easily transformed into LNPs, where the main structure of lignin is preserved. The structure of LNPs enables efficient encapsulation of insoluble molecules, such as pesticides. Therefore, LNPs possess high antimicrobial activity and a potential for application in agrochemistry.[3] In summary, lignin offers a promising and sustainable foundation for the development of high-value nanomaterials with multifunctional applications.

Keywords:

Waste, lignin, lignin nanoparticles, lignin carbon quantum dots

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Tunable preparation of methano and furano-fused fullerenes and their applications

Veselin Maslak

University of Belgrade-Faculty of Chemistry, Belgrade, Serbia, e-mail: vmaslak@chem.bg.ac.rs

Abstract:

Covalent functionalization of fullerenes is very important for their application in materials science, biology, and medicine. Their solubility, reactivity, and electrochemical properties can be significantly improved by introducing various functional groups onto the fullerene surface. Over the past three decades, a wide variety of procedures for the functionalization of fullerenes have been developed, among which cycloaddition reactions are the most prominent, including the Bingel, Prato, and Diels–Alder reactions. β-Keto esters are important synthons in organic synthesis owing to their versatile reactivity, arising from the presence of both carbonyl groups and an activated methylene position. In our laboratory, we have developed a tunable procedure for the preparation of methano- and furano-fused fullerene derivatives through the reaction between C_{60} and β-keto esters. Under the standard Bingel-Hirsch approach, the addition of iodine to a reaction mixture containing C_{60} and β-keto ester leads to the formation of methanofullerene via cyclopropanation. In contrast, when iodine is replaced with TEMPO, the reaction pathway is altered: β-keto esters are converted into furano-fused C_{60} derivatives through an oxidative [3+2] cycloaddition process. The electronic characteristics of synthesized methano and furano-fullerens make them attractive candidates for application in the fabrication of photovoltaic devices. Their tunable energy levels, efficient electron-accepting properties, and improved solubility facilitate their incorporation into active layers of perovskite solar cells, where they can enhance charge separation and transport, ultimately contributing to improved device performance. By linking two fullerene units to a sugar-based platform, we obtained dumbbell-like molecules. These molecules are capable of forming pseudorotaxane with electron-donating components such as [10]cycloparaphenylene, through noncovalent host–guest interactions.

Keywords:

Fullerene, β-keto ester, cyclopropanation, oxidative cycloaddition

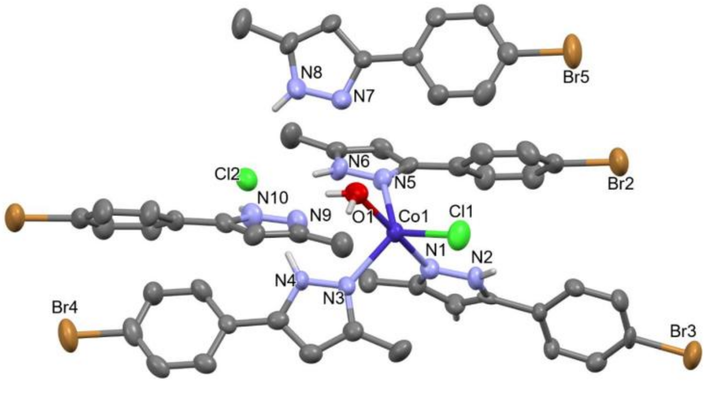
Synthesis and crystal structure of Co(II) complex with 5-(4-bromophenyl)-3-methyl-1H-pyrazole

David Kočović[1], Sergiu G. Shova[2] Željko Jaćimović[3],

[1]Institute for medicines and medical devices, Podgorica, Montenegro, e-mail: david.kocovic@cinmed.me
[2]Inorganic Polymer Department 'Petru Poni', Institute of Macromolecular Chemistry, Iasi, Romania
[3]Faculty of Metallurgy and Technology, University of Montenegro, Podgorica, Montenegro

Abstract:

By reacting warm ethanol solution of $CoCl_2$ with the ligand 5-(4-bromophenyl)-3-methyl-1H-pyrazole, in a 1:2 molar ratio, a complex of formula $[CoL_3Cl·H_2O]$ has been obtained. Slow crystallization over three days produced multiple crystalline phases, including two coordination complexes and unreacted ligand. The structure of $[CoL_3Cl·H_2O]$ was determined using single-crystal X-ray diffraction (SC-XRD). The complex crystallizes in triclinic system with the space group P-1 and exhibits a mononuclear structure with unit cell dimensions of *a=10.0202, b=11.9578, c=13.1092*, and unit cell angles of *α=110.701, β=108.951, γ=94.782*. The geometry of Co(II) is described as a trigonal bipyramidal coordination geometry, with three nitrogen atoms from pyrazole ligands in the equatorial plane, while a chloride ion and a water molecule occupy axial positions. Coordination occurs via *pyridine*-like nitrogen atoms, and prototrophic tautomerism within the ligand is observed. The crystal packing is stabilized by hydrogen-bonding interactions involving coordinated ligands, water molecules, and chloride anions, as well as additional interactions with uncoordinated ligand molecules.



Keywords:

Cobalt, Complex; 5-(4-bromophenyl)-3-methyl-1H-pyrazole; Synthesis, Single-crystal X-ray diffraction (SC-XRD)

Poster Session PO1

Chemical-analytical methods for determination of CBD in selected forenzic samples

Aida Šapčanin[1], Gordan Jančan[2*], Maja Malenica[1], Željko Jaćimović[3]

[1] University of Sarajevo-Faculty of Pharmacy, Sarajevo, BiH, ida@bih.net.ba
[2] CHEMILAB d.o.o., Ljubljana Slovenia
[3] University of Montenegro, Faculty of Tehnology, Podgorica, Montenegro

Abstract:

Cannabidiol (CBD) is one of the 80 chemically active components (commonly called cannabinoids) of the *Cannabis Sativa* plant, popularly known as hemp or marijuana. Its use dates back to ancient civilizations that used it to treat many conditions such as epilepsy, various types of chronic pain, inflammatory conditions in arthritis, appetite suppression, until today when used in the highest percentage in chronic pain, anxiety, treatment of nausea and related for chemotherapy, multiple sclerosis, glaucoma and AIDS, and has found special interest and application in the treatment of epileptic seizures. A few years ago, the FDA approved the first drug produced from cannabis for these conditions, Epidiolex, which contains CBD and is safe for use in the pediatric population. Unlike tetrahydrocannabinol (THC), which is the most abundant in cannabis, CBD as the second most abundant active substance has no psychotropic effect. It is also responsible for reducing the anxiety caused by the use of THC. The aim of the study was to examine samples of cigarettes and rolls, which contain herbal substance suspected to be *Cannabis Sativa,* for the presence of CBD. Samples from forensic seizures were analyzed at the Center for Forensic Investigations, Expertise and Research Sarajevo of the Federal Ministry of the Interior. Using spot testing, TLC and GC-MS methods, CBD identifications were performed in the examined samples. Samples showed a positive result for the presence of CBD.

Keywords:

CBD, forenzic samples, TLC method, GC-MS method

PO1-3

Serum Lipid Profile in Male Wistar Rats Treated with High-Fat and High-Carbohydrate Diets

Ajdin Mujezin[1,2], Atifa Ajanović[1], Ivona Alilović[1], Aida Ajanović[1], Ahmed Smajlović[1],
Amina Magoda[1], Emra Toromanović[3], Vladan Simić[4], Ismet Tahirović[2]

[1]University of Sarajevo - Veterinary Faculty, Sarajevo, Bosnia and Herzegovina,
ajdin.mujezin@vfs.unsa.ba
[2]University of Sarajevo - Faculty of Science, Sarajevo, Bosnia and Herzegovina
[3]University of Sarajevo - Medical Faculty, Sarajevo, Bosnia and Herzegovina
[4]Veterinary Laboratory SmartLab, Belgrade, Serbia

Abstract:

High-fat and high-carbohydrate diets (HFD and HCD, respectively) can lead to various metabolic disorders, including dysregulation of the blood lipide profile. This study aimed to evaluate the effects of HFD and HCD on the serum lipid profile (total cholesterol-TC and triglycerides-TG) in Wistar rats. Six adult male Wistar rats, previously fed chow until they reached 200 g body weight, were randomly allocated into two experimental groups. One group was fed an HFD, and the other group an HCD (n=3 per group) for 12 weeks. Blood samples were collected from the rats' tails every three weeks, for a total of four sampling sessions. Subsequently, serum was isolated from whole blood, and the concentrations of TC and TG were measured. The data were statistically analyzed, with statistical significance defined as $p<0.05$. The F-test was used to assess the equality of variances. Based on the p-values obtained, either Student's t-test or Welch's t-test was subsequently applied for group comparisons. Welch's t-test revealed that serum TC concentrations in the HFD group were significantly higher ($p<0.05$) than those in the HCD group at all four sampling sessions (1.53±0.41 mmol/L and 0.96±0.12 mmol/L, respectively). In contrast, Student's t-test revealed no statistically significant difference ($p>0.05$) in serum TG concentrations between the two experimental groups mentioned above at all four sampling sessions (0.68±0.27 mmol/L and 0.72±0.29 mmol/L, respectively). Overall, HFD significantly increased serum TC concentrations, whereas HCD caused a slight increase in serum TG concentrations.

Keywords:

High-fat diet, High-carbohydrate diet, Total cholesterol, Triglycerides, Male Wistar rats

PO1-4

Fungicidal effect of the newly synthesized complex $Mn_2(L\text{-}H)_2 \cdot H_2O$ on fungus *Botryosphaeria dothidea*

Ana Radović[1], Željko Jaćimović[2], Miljan Bigović[3], Bogoljub Kandić[4], Nedeljko Latinović[4],

[1]Accreditation Body of Montenegro, e-mail: ana.radovic@akreditacija.me
[2,3] Faculty of Natural Science, Study program Chemistry, University of Montenegro
[4]Biotechnical Faculty , University of Montenegro

Abstract:

The practical application of pyrazole derivatives and their metal complexes as active fungicidal agents has prompted the investigation of the potential fungicidal activity of the newly synthesized complex $Mn_2(L–H)_2 \cdot H_2O$ the phytopathogenic fungus *Botryosphaeria dothidea,* the causal agent of bark necrosis, shoot dieback, and fruit rot in numerous plant species, under laboratory conditions using indirect *in vitro* assays. The complex compound $Mn_2(L–H)_2 \cdot H_2O$ was synthesized via a reaction between methanolic solutions of $Mn(OAc)_2 \cdot 4H_2O$ and the ligand 4-bromo-3-nitro-1Hpyrazole-5-carboxylic acid (L). This Mn complex was characterized by CHNS analysis and IR spectroscopy and XRD. To evaluate the potential fungicidal activity of $Mn_2(L–H)_2 \cdot H_2O$, solutions of the following concentrations were prepared: $1 \cdot 10^{-3}$, $5 \cdot 10^{-4}$, $2.5 \cdot 10^{-4}$, $1.2 \cdot 10^{-4}$, and $0.6 \cdot 10^{-4}$ (mol dm^{-3}) and standard azoxystrobin. The obtained results indicate that all tested concentrations of $Mn_2(L–H)_2 \cdot H_2O$ exhibit fungicidal activity against *Botryosphaeria dothidea*, as reflected by a reduction in mycelial diameter by 3.0 cm, 2.8 cm, 0.9 cm, 0.7 cm, and 0.5 cm, respectively, compared to the control sample (LSD_{50} (0.01) = 0.065) and the azoxystrobin. The highest fungicidal activity of the $Mn_2(L–H)_2 \cdot H_2O$ complex was observed at a concentration of $1 \cdot 10^{-3}$ mol dm^{-3}, which exhibited 42.80% inhibition of *Botryosphaeria dothidea* mycelial growth relative to the control.

Keywords:

Complex compounds of pyrazole derivatives, Mn complex, *Botryosphaeria dothidea*, *in vitro* studies

PO1-5

In vitro studies of the newly synthesized complex Co $(L\text{-}H)_2 \cdot 2H_2O$ against the fungus *Diaporthe ampelina*

Ana Radović[1], Željko Jaćimović[2], Milica Vujić[3], Bogoljub Kandić[4], Nedeljko Latinović[4],

[1]Accreditation Body of Montenegro , e-mail: ana.radovic@akreditacija.me
[2,3] Faculty of Natural Science, Study program Chemistry, University of Montenegro
[4]Biotechnical Faculty , University of Montenegro

Current scientific knowledge on the biological effectiveness of pyrazoles and their metal complexes highlights the significance of the synthesis and structural characterization of new pyrazole-based metal complexes, as well as the evaluation of their potential application as active fungicidal agents. The complex $Co(L–H)_2 \cdot 2H_2O$ was synthesized via a reaction between methanolic solutions of $Co(OAc)_2 \cdot 4H_2O$ and the ligand 3-(4-chlorophenyl)-1H-pyrazole (L). This Co complex was characterized by CHNS analysis, IR spectroscopy and XRPD technique. In indirect *in vitro* assays employed two commercial fungicides, Cabrio Top (active ingredients: pyraclostrobin and metiram) and azoxystrobin, as relevant standards for evaluating the potential fungicidal activity of the newly synthesized Co pyrazole complex against the fungus *Diaporthe ampelina* the causal agent of cane and leaf necrosis, shoot dieback, and fruit spotting in grapevine. Solutions of $Co(L–H)_2 \cdot 2H_2O$ at the following concentrations ($1 \cdot 10^{-3}$, $5 \cdot 10^{-4}$, $2.5 \cdot 10^{-4}$, $1.2 \cdot 10^{-4}$ and $0.6 \cdot 10^{-4}$ mol dm^{-3}) were prepared to determine its potential fungicidal activity. The obtained results indicate statistically significant effects at concentrations of $1 \cdot 10^{-3}$ mol dm^{-3} and $2.5 \cdot 10^{-4}$ mol dm^{-3} of the $Co(L–H)_2 \cdot 2H_2O$ complex, as evidenced by a reduction in the mycelial diameter of *Diaporthe ampelina* by 1.2 cm (first measurement), 1.8 cm (second measurement), and 1.4 cm (third measurement), compared to the control sample (LSD_{50} (0.01) = 1.034).

Keywords:
3-(4 chlorophenyl)-1H-pyrazole, cobalt pyrazole complex, fungicidal effects, *Diaporthe ampelina*

PO1-6

Changes in Cholesterol Concentrations in Human Blood with Age

Atifa Ajanović[1], **Ajdin Mujezin**[1,2], Aida Ajanović[1], Ivona Alilović[1], Ismet Tahirović[2],
Emin Sofić[2,3]

[1]University of Sarajevo - Veterinary Faculty, Sarajevo, Bosnia and Herzegovina,
ajdin.mujezin@vfs.unsa.ba
[2]University of Sarajevo - Faculty of Science, Sarajevo, Bosnia and Herzegovina
[3]University of Sarajevo - Faculty of Pharmacy, Sarajevo, Bosnia and Herzegovina

Abstract:

Cholesterol is a crucial component of the cell membrane and serves as a precursor of steroid hormones and bile acids. The goal of this study was to determine the cholesterol concentrations (ChCs) in human blood in relation to age. Cholesterol was measured in blood plasma (806 samples) and whole blood (787 samples) from men and women aged 0.6 to 90 years, using a spectrophotometric method based on the Liebermann-Burchard reaction. All samples were divided into four age groups: children (≤12 years), adolescents (13-20 y.), work-active subjects (21-60 y.), and elderly subjects (≥61 y.). Following the measurements, the collected data were subjected to statistical analysis. Normality of data distribution was assessed using the Kolmogorov-Smirnov test (α=0.001). As the calculated p-value was less than 0.001, indicating a deviation from the normal distribution, the Mann-Whitney U test was performed at the 99.9% confidence level. The plasma ChCs of all males (397) were very similar to those of all females (409) (4.64±0.96 mmol/L and 4.73±0.92 mmol/L, respectively). However, plasma ChCs increased mainly with age in both genders. Also, whole blood ChCs of all male subjects (392) were not significantly different from those of all female subjects (395) (15.76±1.68 mmol/L and 16.18±1.30 mmol/L, respectively). In subjects of both genders, the ChCs in whole blood increased continuously from the youngest to the work-active group. In elderly male subjects, whole blood ChCs slightly decreased without statistical significance, whereas in elderly female subjects, whole blood ChCs were significantly lower compared with their work-active group (p***<0.001, Mann-Whitney U test). The cholesterol ratio in plasma and whole blood was ≈1:3.4 in all aging groups.

Keywords:

Cholesterol, Human plasma, Human whole blood, Age, Gender

Competitive adsorption of selected heavy metals on calcite

Bojana Knežević Vulićević[1], Vlatko Kastratović[2]

[1]Center for Ecotoxicological Research Podgorica, Podgorica, Montenegro, e-mail: bojana.knezevic@ceti.me
[2]Faculty of Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro

The adsorption of heavy metals in natural waters rarely occurs in single-component systems, as dissolved ions simultaneously compete for available adsorption sites. Understanding these interactions is therefore essential when evaluating mineral materials for water treatment. This study investigates the competitive adsorption behavior of selected heavy metals (Fe^{3+}, Cu^{2+}, Pb^{2+}, Zn^{2+} and Cd^{2+}) on calcite to identify differences in their competitive abilities. Batch adsorption experiments were performed in single and binary systems at pH 5. Initial metal concentrations were adjusted to achieve approximately 50% removal in single-component systems, enabling clearer identification of competitive effects. The results obtained reveal pronounced differences in adsorption behavior depending on the metal combination. Pb^{2+} exhibited a strong inhibitory effect, completely suppressing the adsorption of other metals in binary systems. In contrast, Fe^{3+} maintained stable adsorption behavior and even showed increased removal efficiency in the presence of several competing ions, indicating possible synergistic effects. Cu^{2+} displayed intermediate behavior: the presence of Fe^{3+} enhanced its adsorption, while Zn^{2+} and Cd^{2+} reduced its removal efficiency. Zn^{2+} and Cd^{2+} were the most sensitive to competitive conditions, showing reduced adsorption in all binary combinations. To quantitatively describe these interactions, a competitive index (CI) was used as the ratio between adsorption efficiency in binary and single-component systems. The CI analysis confirmed that competitive interactions between metals are strongly asymmetric, with certain ions acting as dominant inhibitors while others are highly susceptible to suppression. These results highlight the importance of considering competitive effects when assessing mineral adsorbents, as adsorption efficiencies obtained in single-metal systems may significantly overestimate performance in complex aqueous matrices.

Keywords:

Calcite, Competitive adsorption, Heavy metals, Binary systems, Water treatment

PO1-8

Synthesis, characterization and bactericidal properties of Cu(II), Pd(II) and Pt(II) complexes with 4-methylpyrazole

David Kočović[1], Aida Šapčanin[2], Suad Hamidović[3], Berina Imamović[3], Željko Jaćimović[4]

[1]Institute for medicines and medical devices, Podgorica, Montenegro, e-mail: david.kocovic@cinmed.me

[2]Faculty of Pharmacy, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

[3]Faculty of Agriculture and Food Sciences, University of Sarajevo, Bosnia and Herzegovina

[4]Faculty of Metallurgy and Technology, University of Montenegro, Podgorica, Montenegro

Abstract:

Three transition metal complexes with 4-methylpyrazole, $[CuL_4(NO_3)_2]$, $[PtL_3Cl_2]$, and $[Pd(L{-}H)_4]$, were synthesized, characterized and evaluated in their bactericidal properties. The Cu(II) complex was obtained in ethanolic medium as blue single crystals, with its hexahedral coordination environment determined by SC-XRD, XRPD, CHN and FTIR analyses. The Pt(II) and Pd(II) complexes were synthesized from potassium tetrachloroplatinate and palladium acetate, respectively, yielding amorphous products. Their molecular structures were determined by XRPD, CHN and FTIR analyses. The antibacterial activity of all three complexes was assessed against *Escherichia coli* and *Salmonella spp*. using the Kirby–Bauer disk diffusion method. All compounds exhibited measurable bactericidal effects, demonstrating that coordination of 4-methylpyrazole to transition metal centers contributes to antimicrobial activity. Variations in activity were observed depending on the central metal ion, with the palladium complex showing a stronger inhibition compared to other complexes. Despite these findings, none of the complexes reached the efficacy of the reference antibiotic, indicating limited overall antibacterial potency. These results highlight the influence of metal identity on bactericidal properties and suggest the need for further structural optimization.

Keywords: Copper, Platinum, Palladium, Complex; 4-methylpyrazole; Physico-chemical characterization; Antimicrobial activity

PO1-9

HPLC test method for the determination of cannabinoids in different samples in routine quality control

Gordan Jančan[1], Aida Šapčanin[2],Željko Jaćimović[3]

[1]CHEMILAB d.o.o., Ljubljana Slovenia, ida@bih.net.ba
[2]University of Sarajevo-Faculty of Pharmacy, Sarajevo, BiH

[3] University of Montenegro, Faculty of Tehnology, Podgorica, Montenegro

Abstract:

A simple quantitative reverse-phase high-performance liquid chromatography (RP HPLC) method was developed and validated for the determination of cannabinoids in products containing oil or parts of the cannabis plant. The HPLC method was developed and optimized on selected chromatographic columns from Waters and Agilent, using mobile phases of different compositions and using an ultraviolet-visible (UV/Vis) detector at wavelengths of 210 nm, 219 nm and 224 nm (UV spectra 190 - 600 nm). Isocratic elution of samples was performed on columns: WATERS XTerra RP18, 3.5 µm, 150 x 4.6 mm with a mobile phase containing water/trifluoroacetic acid (TFA)/methanol in the ratio 500/3/2500, with a mobile phase flow rate of 0.75 mL/min, using an ultraviolet-visible (UV/Vis) detector at a wavelength of 219 nm (+ UV spectra 190 - 600 nm), injection volume: 5 µL and AGILENT InfinityLab Poroshell C18, 2.7 µm, 150 x 4.6 mm with a mobile phase containing 20 mM ammonium formate, pH=3.2/acetonitrile/ methanol in the ratio 2/7/1 (V/V/V), with a mobile phase flow rate of 1.0 mL/min, using an ultraviolet-visible (UV/Vis) detector at wavelengths 210 nm, 224 nm (+ UV spectra 190 - 600 nm). The RP HPLC method has been tested to meet regulatory requirements necessary for its intended use in routine quality control. The test method has been successfully used to quantify selected cannabinoids: Δ^9-trans-tetrahydrocannabinol (Δ^9-THC), Δ^8-trans-tetrahydrocannabinol (Δ^8-THC), Δ^9-trans-tetrahydrocannabinolic acid (THCA), Tetrahydrocannabivarin (THCV), Cannabidiol (CBD), Cannabidiolic acid (CBDA), Cannabidivarin (CBDV), Cannabidivarinic acid (CBDVA), Cannabigerol (CBG), Cannabigerolic acid (CBGA), Cannabinol (CBN), Cannabichromene (CBC) and Cannabicyclol (CBL) in commercial products containing hemp oil, such as capsules, oral drops and tinctures.

Keywords:

Cannabinoid, HPLC, isocratic elution, ultraviolet-visible detector

PO1-10

COSMO-RS screening of hydrophobic deep eutectic solvents for aristolochic acids extraction

Ilija Cvijetić[1], Petar Ristivojević[2]
[1]University of Belgrade, Faculty of Chemistry, Belgrade, Serbia, e-mail: ilija@chem.bg.ac.rs

Abstract:

Aristolochic acids (AAs) are highly nephrotoxic and carcinogenic natural compounds strongly associated with the incidence of Balkan endemic nephropathy, making their removal from the environment a critical public health priority. This study aims to identify hydrophobic deep eutectic solvents (hDES) capable of efficiently extracting Aas from aqueous media, and to evaluate potential integration of hDES into porous carriers for water purification applications.

A comprehensive COSMO-RS screening was performed on 1200 theoretical hDES mixtures to predict the affinity of six aristolochic acids and aristolactam. Activity coefficients at infinite dilution ($\gamma\infty$) were calculated using COSMOtherm, providing a quantitative measure of solute-solvent interactions and enabling systematic ranking of candidate solvents. The screening focused on identifying strongly hydrophobic, structurally tunable, and synthetically accessible binary mixtures.

COSMO-RS predictions suggested that aristolochic acid C exhibits the lowest activity coefficients ($\ln\gamma = -15.6$) in a 1:1 mixture of tetrabutylammonium bromide (TBAB) and lysine. This hDES demonstrates both strong hydrophobicity and favorable interactions, making it the most promising candidate for targeted AAs extraction.

The TBAB:lysine hDES shows outstanding theoretical potential for aristolochic acid removal and represents a promising next-generation sorbent phase. The next stage of this work involves incorporating this hDES into a porous carrier to produce a functionalized sorbent material suitable for water purification. Experimental validation of extraction efficiencies and material stability will provide essential insights for future implementation in environmental remediation technologies.

Keywords: COSMO-RS, rational solvent design, extraction, hydrophobic deep eutectic solvents, water treatment

Acknowledgments

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PO1-11

COMPARISON OF ULTRASONIC BATH AND PROBE FOR NADES-ASSISTED EXTRACTION OF CAROTENOIDS

Marija Kaluđerović[1], Petar Ristivojević[2], Dragana Dabić Zagorac[3], Miljan Bigović[1]

[1]University of Montenegro – Faculty of Natural Sciences and Mathematics, Podgorica, Montenegro,
e-mail:marija.ka@ucg.ac.me
[2]University of Belgrade – Faculty of Chemistry, Belgrade, Serbia
[3]Innovative Centre of the Faculty of Chemistry, University of Belgrade, Belgrade, Serbia

This study compared the efficiency of ultrasound-assisted extraction using an ultrasonic bath and an ultrasonic probe coupled with a hydrophobic natural deep eutectic solvent (NADES) for the extraction of carotenoids from carrots. Octanoic acid and decanoic acid in a 3:1 molar ratio were used to prepare NADES. Extractions were performed at sample-to-solvent ratios of 1:10 and 1:50. Bath extractions were conducted at 50 °C for 1a5 minutes (Zhang et al., 2021). Ultrasonic probe extractions were performed at an amplitude of 40% and continuous mode for 3 minutes, with the sample vessel cooled in an ice bath to prevent overheating**.** Extraction efficiency was monitored by measuring absorbance at wavelengths of 405, 430, and 455 nm. The extraction efficiency of the ultrasonic probe and bath exhibited a clear dependence on the solid-to-solvent ratio. At 1:10, the probe was superior (absorbance >1.7 vs. 1.28 for bath). However, at 1:50, the ultrasonic bath proved more efficient, with measurable absorbances (up to 0.32), while probe extraction yielded almost no detectable carotenoids (Figure 1). The intense probe energy may promote degradation in dilute systems, whereas gentler bath energy is better suited for larger solvent volumes. The solid-to-solvent ratio is a critical factor that can reverse the expected efficiency order of ultrasonic systems.

Keywords: ultrasound extraction, probe vs. bath, carotenoids, NADES, solid-to-solvent ratio.

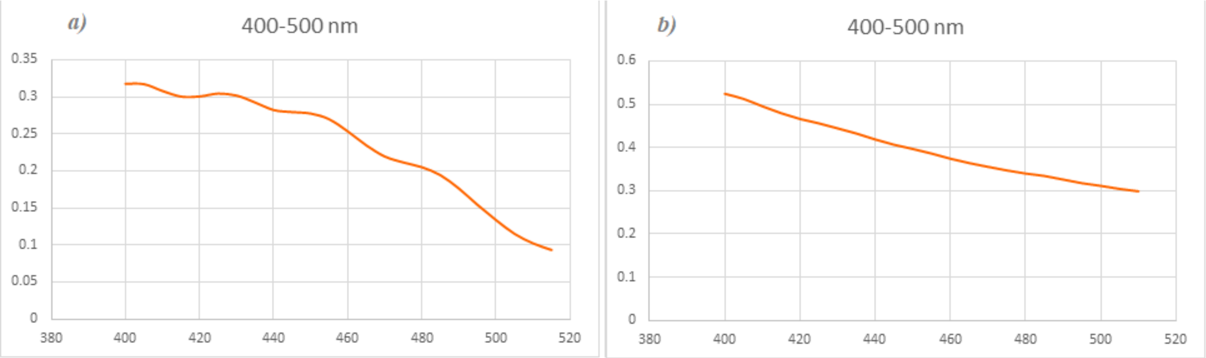


Figure 1. Comparison of extraction efficiency at 1:50 ratio: a) ultrasonic bath vs. b) ultrasonic probe.

Synthesis and biological evaluation of new pyrrolo[3,4-*c*]quinoline-1,3-dione–chalcone hybrids as dihydroorotate dehydrogenase inhibitors

Marina G. Dimitrijević *[1], Milan D. Joksović [1]

[1]University of Kragujevac, Faculty of Science, Institute of Chemistry, Kragujevac, Serbia,

e-mail: marina.dimitrijevic@pmf.kg.ac.rs

Abstract:

Human dihydroorotate dehydrogenase (hDHODH) is a key enzyme in de novo pyrimidine biosynthesis and represents an important therapeutic target for the development of anticancer agents. In this study, a new pyrrolo[3,4-c]quinoline-1,3-dione–chalcone hybrid was designed and synthesized from o-aminoacetophenone and p-chlorobenzaldehyde via Claisen–Schmidt condensation, followed by cyclization to afford the corresponding pyrrolo[3,4-c]quinoline-1,3-dione scaffold. The structure of the obtained compound was confirmed by ^{1}H NMR, ^{13}C NMR and IR spectroscopy. The biological activity was evaluated *in vitro* through inhibition of human DHODH and cytotoxicity assays against HaCaT (immortalized human keratinocytes) and A375 (human melanoma) cell lines. The synthesized hybrid exhibited potent hDHODH inhibitory activity with an IC_{50} value of 0.96 µM, comparable to the reference drug leflunomide (IC_{50} = 0.79 µM). In addition, the compound showed notable cytotoxic effects, with IC_{50} values of 15.05 ± 1.8 µM for HaCaT and 11.29 µM for A375 cells, indicating higher sensitivity of malignant cells. These results suggest that this pyrrolo[3,4-c]quinoline-1,3-dione–chalcone hybrid represents a promising lead candidate for further optimization and development of novel DHODH-targeting anticancer agents.

Keywords:

Chalcone, Pyrrolo[3,4-c]quinoline-1,3-dione, Dihydroorotate dehydrogenase (hDHODH), Anticancer activity, hDHODH inhibitors

PO1-13

Novel 2,6-diacetylpyridine derivative zinc(II) complexes from one-step synthesis

Marijana S. Regojević[1], **Ljiljana S. Vojinović-Ješić**[1], Berta Barta Holló[1], Marko V. Rodić[1], Mirjana M. Radanović[1]

[1]Universtity of Novi Sad Faculty of Sciences, Novi Sad, Serbia e-mail: ljiljana.vojinovic-jesic@dh.uns.ac.rs

Phenylhydrazone-based Schiff bases are versatile ligands in coordination chemistry, forming stable metal complexes that often exhibit enhanced biological and functional properties. Their structural diversity, ability to coordinate multiple metal centers, and intriguing chemical behavior make them a compelling subject for ongoing research. In this work, two complexes of 2,6-diacetylpyridine bis(phenylhydrazone) – L, were successfully prepared in a single synthetic step and characterized by elemental analysis, molar conductivity measurements, IR spectroscopy, and single-crystal X-ray diffraction.

Complex compounds $[ZnL_2]I_2$ (**1**), and $[ZnL_2][ZnI_4]\cdot Me_2CO$ (**2**) were synthesized by reacting ZnI_2 with L in a molar ratio of 1:1 in acetone under heating. Red crystals of complex **1** and orange crystals of complex **2**, both suitable for single-crystal X-ray diffraction, were obtained by slowing the crystallization process using perforated Parafilm.

Comparison of the infrared spectra of the ligand with those of the obtained complexes confirmed coordination, while the precise structures were verified by single-crystal X-ray diffraction. In both bis(ligand) complexes, the ligand achieves hexadentate N_6 coordination, resulting in the formation of four five-membered metallocycles around the central atom. The Zn(II) coordination environment in both complexes can be described as a distorted octahedron, where the basal plane is formed by one azomethine nitrogen atom from each L molecule and the pyridine nitrogen atoms, while the remaining two azomethine nitrogen atoms occupy the axial positions. The crystal structures are further stabilized by $\pi\cdots\pi$ and $C–H\cdots\pi$ interactions, as well as by hydrogen bonding.

The successful one-step synthesis of these Zn(II) complexes with well-defined hexadentate coordination highlights their potential as platforms for designing new metal–ligand architectures, inviting future exploration of their catalytic, optical, or biological applications.

Keywords:

Schiff base, Zn(II) complex, 2,6-diacetypyridine derivative, phenylhydrazone derivative, one-step synthesis

PO1-14

Silver(I) complex with 3-(1-Pyrazolyl)-L-alanine: Structure and antioxidant activity

Marijana S. Regojević[1], Paul Thomashausen[2], Milica G. Bogdanović[1], Ljiljana S. Vojinović-Ješić[1], Ivana Đ. Borišev[1], Goran N. Kaluđerović[2], Mirjana M. Radanović[1]

[1]Universtity of Novi Sad Faculty of Sciences, Novi Sad, Serbia e-mail: mirjana.lalovic@dh.uns.ac.rs
[2]University of Applied Sciences Merseburg - Department of Engineering and Natural Sciences, Merseburg, Germany

Coordination chemistry has evolved into a key field with broad applications in catalysis, medicine, and materials science, with pyrazole derivatives playing a significant role due to their versatile coordination and hydrogen-bonding abilities. In this work, a novel silver(I) complex with 3-(1-pyrazolyl)-L-alanine (pzAla) was synthesized and characterized by elemental analysis, molar conductivity measurements, IR spectroscopy, and single-crystal X-ray diffraction. Also, its antioxidative properties were investigated.

Whitish crystals of the complex of formula $[Ag_2(pzAla)_2](NO_3)_2$ were obtained from an aqueous solution of equimolar amounts of pzAla and $AgNO_3$ in the dark. The obtained product was filtered and washed with water to remove degradation products.

The molecular structure of this complex in the asymmetric unit consists of two Ag^+ ions, two zwitterionic pzAla molecules, and two nitrate anions, with each silver atom coordinated by one nitrogen and three oxygen atoms. The free pyrazole nitrogen atom binds to one metal center, while one carboxyl oxygen coordinates to the same Ag^+ and simultaneously to the other Ag^+ within the asymmetric unit. The crystal structure of the compound is stabilized by hydrogen bonds between NH_3^+ groups and nitrate anions, forming an organized polymeric network.

The complex exhibits higher antioxidant activity – 272.30 μg TE/g dsm (Trollox equivalent per gram of dry sample mass) compared to the free ligand (176.51 μg TE/g dsm).

The novel silver(I) complex was synthesized and structurally characterized, showing a well-defined coordination environment and promising antioxidative activity. Further studies are needed to explore the role of the counterion on stability and bioactivity, as well as to assess its potential in medicinal and materials applications.

Keywords:
Pyrazole derivative, silver(I) complex, amino acid derivative, coordination chemistry, antioxidant activity

Docking-guided design and synthesis of L-DOPA– pyrrolo[3,4-c]quinoline-1,3-dione hybrids as potential hDHODH Inhibitors

Marina G. Dimitrijević*[1], Milan D. Joksović[1]

[1]University of Kragujevac, Faculty of Science, Institute of Chemistry, Kragujevac, Serbia,

e-mail: marina.dimitrijevic@pmf.kg.ac.rs

Abstract:

Human dihydroorotate dehydrogenase (hDHODH) is an attractive therapeutic target for the treatment of cancer, autoimmune, infectious, and metabolic diseases. Based on previously reported tyrosine-derived hDHODH inhibitors, a rational design approach was employed to explore structural modifications with improved binding affinity. Molecular docking studies indicated that L-DOPA–based derivatives exhibit more favorable binding energies within the hDHODH active site compared to the tyrosine scaffold (MolDock Score: −158.18 vs −149.50). Accordingly, a new series of L-DOPA–derived pyrrolo hybrid compounds was designed and synthesized. The structures of the obtained compounds were confirmed by ^{1}H NMR, ^{13}C NMR, and IR spectroscopy. The synthesized compounds are intended for further in vitro evaluation, including hDHODH inhibition and cytotoxicity assays, to assess their potential as novel enzyme inhibitors. These findings provide a strong basis for further optimization of L-DOPA–based pyrrolo hybrids as potential hDHODH-targeting agents.

Keywords:

Dihydroorotate dehydrogenase (hDHODH), L-DOPA derivatives, Pyrrolo[3,4-c]quinoline-1,3-diones, Molecular docking, Structure-based design

PO1-16

Antimicrobial Properties of Silver(I) Complexes with Miconazole

Mia Stanković[1]*, Nevena Lj. Stevanović[2], Tina P. Andrejević[2], Darko P. Ašanin[3], Bojana V. Pantović[2], Sanja Škaro Bogojević[4], Biljana Đ. Glišić[2]

[1]Faculty of Metallurgy and Technology, University of Montenegro, Džordža Vašingtona bb, 81000 Podgorica, Montenegro, e-mail: mia.v@ucg.ac.me
[2]Faculty of Science, University of Kragujevac, Radoja Domanovića 12, 34000 Kragujevac, Serbia
[3]Institute for Information Technologies Kragujevac, University of Kragujevac, Liceja Kneževine Srbije 1A, 34000 Kragujevac, Serbia
[4]Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Vojvode Stepe 444a, 11042 Belgrade, Serbia

Abstract:

To develop new antimicrobial agents, the clinically approved antifungal azole miconazole (mcz) was employed as a ligand for the synthesis of novel silver(I) complexes, $[Ag(mcz)_2]CF_3SO_3$ (Ag1) and $[Ag(mcz)_2]PF_6$ (Ag2). These complexes were characterized by spectroscopic (^1H NMR, IR and UV-Vis) methods, while the crystal structure of Ag2 was determined by single-crystal X-ray diffraction analysis. Structural analysis revealed that in both complexes two mcz ligands are monodentately coordinated to the silver(I) ion *via* the imidazole nitrogen atom, resulting in a distorted linear geometry around the metal center. The antimicrobial activity of Ag1 and Ag2 was evaluated against Gram-negative bacteria (*Escherichia coli* NCTC 9001 and *Pseudomonas aeruginosa* PAO1), Gram-positive bacteria (*Staphylococcus aureus* ATCC 25923, *S. aureus* NCTC 6571, and clinical isolates *S. aureus* MRSA VL-382762, *S. aureus* 80100861 and *Listeria monocytogenes* NCTC 11994) and *Candida* species (*C. albicans* ATCC 10231, *C. parapsilosis* ATCC 22019, *C. glabrata* ATCC 2001 and *C. krusei* ATCC 6258). Both complexes exhibited good to excellent antimicrobial activity against the tested strains, with minimum inhibitory concentration (MIC) values ranging from 3.9 to 62.5 µg/mL. Moreover, complexes Ag1 and Ag2 demonstrated stronger antibacterial than antifungal activity compared with the corresponding mcz ligand. The most pronounced effects were observed for *E. coli* and *L. monocytogenes*, with MIC values for Ag1 and Ag2 complexes that were 8- and 32-fold lower, respectively, than those for mcz. Among the tested compounds, the Ag2 complex exhibited the highest antimicrobial activity, highlighting the potential of silver(I) complexes with azoles as promising candidates for the development of new antimicrobial agents.

Keywords:

Silver(I) complexes, Miconazole, Characterization, Antibacterial activity, Antifungal activity

PO1-17

Investigation of the Binding Affinity of a Silver(I) Complex with 1,6-Naphthyridine toward Biologically Relevant Molecules

Mia Stanković[1*], Tina P. Andrejević[2], Nevena Lj. Stevanović[2], Darko P. Ašanin[3], Ivana Vučenović[4], Bojana V. Pantović[2], Biljana Đ. Glišić[2]

[1]Faculty of Metallurgy and Technology, University of Montenegro, Džordža Vašingtona bb, 81000 Podgorica, Montenegro, e-mail: mia.v@ucg.ac.me
[2]Faculty of Science, University of Kragujevac, Radoja Domanovića 12, 34000 Kragujevac, Serbia
[3]Institute for Information Technologies Kragujevac, University of Kragujevac, Liceja Kneževine Srbije 1A, 34000 Kragujevac, Serbia
[4]Faculty of Agriculture, University of Niš, Kosančićeva 4, 37000 Kruševac, Serbia

Abstract:

Silver(I) compounds are well-known antimicrobial agents due to their pronounced toxicity toward microorganisms. The increasing resistance of bacteria to clinically used antibiotics has renewed interest in silver(I) complexes, whose activity is thought to arise from interactions with essential biomolecular targets, including proteins and DNA. Additionally, their antimicrobial effects are generally attributed to the slow release of silver(I) ions from the complexes, a critical step underlying their biological activity. A prominent example of their clinical application is silver(I) sulfadiazine (AgSD), which is widely used in the treatment of burn wounds. Importantly, the antimicrobial efficacy of these complexes is strongly influenced by the nature of the ligand donor atoms coordinated to the silver(I) ion. In this work, we examined the interactions of a previously synthesized silver(I) coordination polymer, $\{[Ag(1,6\text{-naph})(H_2O)](BF_4)\}_n$ (1,6-naph is 1,6-naphthyridine), with calf thymus DNA (ct-DNA) and bovine serum albumin (BSA) using fluorescence emission spectroscopy in order to evaluate its binding affinities towards these biomolecules. Furthermore, eosin Y (eos Y), ibuprofen (ibu), and digitoxin (dig) were employed as specific markers for binding sites I, II, and III, respectively, to identify the preferred binding site of the investigated complex. Considering previous findings indicating that intercalation is not the predominant mechanism of action, we further examined the affinity of the complex toward ct-DNA by performing competitive binding studies with the minor groove binder Hoechst 33258 (2′-(4-hydroxyphenyl)-5-[5-(4-methylpiperazine-1-yl)benzimidazo-2-yl]benzimidazole) and the major groove binder methyl green (MG). The calculated binding constants indicate that the investigated silver(I) complex displays comparable affinity for all three binding sites of BSA and a preference for ct-DNA binding through minor groove interactions rather than major groove binding.

Keywords:

Silver(I) complexes, 1,6-Naphthyridine, BSA interactions, Site markers, DNA interactions

PO1-18

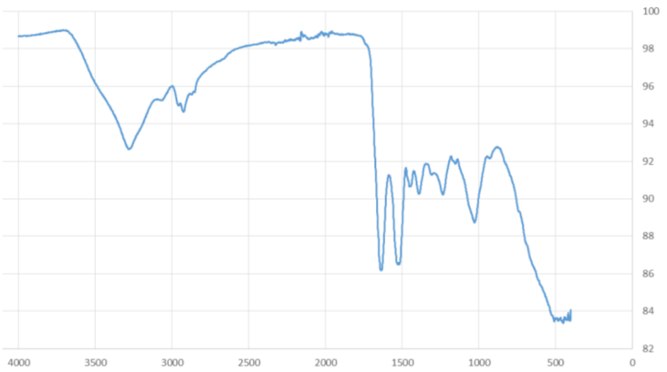
Determination of the composition of human thrombi by the method of FTIR spectroscopy

Miljan Bigović[1], Milovan Roganović[2], Veselin Maslak[3], Marija Kaluđerović[1],
Sandra Vujović[2], Darko Radinović[2], Milica Jovanović[1]

[1]Faculty of Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro,
e-mail:miljan@ucg.ac.me
[2]Clinical Center of Montenegro, Ljubljanksa bb, Podgorica, Montenegro
[3]Faculty of Chemistry, University of Belgrade, Belgrade, Serbia

Abstract:

Stroke is the fifth leading cause of death worldwide, accounting for approximately 6.5 million fatalities each year. Ischemic stroke (IS), resulting from vascular occlusion, represents about 87% of all stroke cases. This spectral range enables clear identification of clot regions enriched in lipids due to the presence of long-chain fatty acids and has also been previously applied for lipid quantification. Dried samples (approximately 10 mg) were finely ground and analyzed using the FTIR (Fourier transform infrared spectroscopy) technique with a diamond crystal (ATR). The various clot components display spectral variations primarily within regions associated with the symmetric (νs) and asymmetric (νas) stretching vibrations of CH_2 groups, observed at 2849 and 2919 cm^{-1}, respectively. These vibrational modes are mainly attributed to a high lipid content or to biomolecules containing long acyl chains. Within the fingerprint region (900–1800 cm^{-1}), as well as in spectral windows characteristic of proteins (Amide I and II; 1480–1800 cm^{-1}) and lipids (CH-stretch; 2750–3010 cm^{-1}), sample preservation proved to be the principal factor influencing the integrity of thrombus ATR–FTIR spectra.



A detailed evaluation of the lipid fraction was performed by comparing the obtained FTIR spectra with those of reference standard compounds. More comprehensive chemical profiling of extracted cerebral thrombi, aimed at elucidating the pathophysiology of ischemic stroke, could be achieved through the application of complementary spectroscopic techniques, especially mass spectrometry and Raman spectroscopy.

Keywords:

Thrombi, FTIR, organic matter, lipids

PO1-19

Disubstituted Schiff Bases: Synthesis and ABTS Antioxidant Evaluation

Miljan Bigović[1], Kristijan Pete[2], Marija Kaluđerović[1], Nevena Prlainović[2*]

[1] Faculty for Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro
[2]Faculty of Technology and Metallurgy, University of Belgrade, Serbia, *nprlainovic@tmf.bg.ac.rs

Abstract:

A series of ten disubstituted thiocarbohydrazone-based Schiff bases bearing different aromatic substituents was synthesized and characterized by ^{1}H and ^{13}C NMR and FTIR spectroscopy. The synthesized compounds were subsequently evaluated for their antioxidant activity using the ABTS radical scavenging assay. The investigated compounds differed in the nature and position of substituents on the aromatic ring, including H, hydroxyl (2-OH, 3-OH, 4-OH, 3,4-diOH), nitro (2-NO_2, 3-NO_2, 4-NO_2), and halogen (4-Br, 4-I) groups. Among all tested compounds, the 3,4-dihydroxy derivative exhibited by far the highest activity (IC_{50} = 0.31 mM), markedly outperforming vitamin C (IC_{50} = 1.54 mM). This pronounced effect can be attributed to the presence of two hydroxyl groups, which enhance hydrogen atom donation ability and stabilize the resulting radical through resonance. The monohydroxyl-substituted derivatives also exhibited notable activity, decreasing in the order 4-OH (1.12 mM) > 2-OH (1.23 mM) > 3-OH (1.32 mM), indicating the favorable effect of hydroxyl groups on ABTS radical scavenging. In contrast, nitro-substituted compounds displayed moderate to weak activity, with the 3-NO_2 derivative being the least active in the series (IC_{50} = 3.94 mM), while 2-NO_2 and 4-NO_2 derivatives showed activities similar to the unsubstituted compound and ascorbic acid. The halogenated derivatives exhibited intermediate activity, with the 4-I derivative (1.79 mM) being more active than the 4-Br analogue (2.43 mM). Overall, the results clearly indicate that electron-donating hydroxyl groups, particularly when arranged in a catechol-like 3,4-dihydroxy pattern, strongly enhance ABTS radical scavenging, whereas electron-withdrawing nitro groups and halogen substituents are less favorable. These findings identify hydroxyl-rich Schiff bases as promising candidates for further development as antioxidant agents.

Keywords:

Schiff-base, thiocarbohydrazone, antioxidant activity, organic synthesis, ABTS assay

Optimization of the synthesis of new Schiff bases of aldehydes with thiocarbohydrazide using an ultrasonic probe

Miljan Bigović[1] ,Milena Bakrač[2], Marija Kaluđerović[1], Nevena Prlainović[3], Željko Jaćimović[2]

[1]Faculty of Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro,
e-mail:miljan@ucg.ac.me
[2]Faculty of Metallurgy and Technology, University of Montenegro, Podgorica, Montenegro.
[3]Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

Abstract:

Schiff's bases are compounds formed by the condensation of aldehydes or ketones with ammonia or primary amines. Their synthesis is quite simple, which contributes to their increasingly wide application. Due to the ability to donate electrons, i.e. the fact that according to Lewis' theory they belong to bases, these compounds are very suitable for the formation of complex compounds with transition metal ions. In our research, with the use of an ultrasonic probe as a modern and efficient method for intensifying chemical reactions, four Schiff's bases with thiocarbohydrazide were synthesized - two monosubstituted and two disubstituted. The use of an ultrasonic probe enabled a faster reaction, better homogenization of the system and a higher yield compared to classical methods. All obtained compounds were characterized using IR spectroscopy. Experimental results indicate that the yields of ultrasonic synthesis were 77.4% after 15 minutes and 73.7% after 20 minutes of reaction. The obtained results clearly indicate the advantage of the ultrasonic method, given that the yields achieved are significantly higher compared to the classical procedure. It was observed that a shorter reaction duration (15 min) leads to a higher yield compared to a longer synthesis time (20 min), which suggests the existence of an optimal ultrasonic treatment time, after which a decrease in yield may occur, probably due to product or reagent degradation. Based on the comparative analysis, it can be concluded that the ultrasonic method, especially with optimal amplitude and pulse mode parameters, enables significantly higher yields and higher efficiency compared to the conventional method, which requires a longer time and gives lower yields. From everything previously stated, it can be concluded that the application of an ultrasonic probe represents a significantly more efficient and practical approach to the synthesis of Schiff bases compared to conventional methods.

Keywords:

Schiff's base, ultrasound probe, synthesis, thiocarbohydrazide

PO1-21

Synthesis and characterization of Schiff bases of some natural aldehydes with thiocarbohydrazide

Miljan Bigović[1] , Milica Đođić[2], Marija Kaluđerović[1], Đura Nakarada[3], Anđela Malović[4]

[1]Faculty of Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro,
e-mail:miljan@ucg.ac.me
[2]Faculty of Metallurgy and Technology, University of Montenegro, Podgorica, Montenegro.
[3]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia
[3]Faculty of Chemistry, University of Belgrade, Belgrade, Serbia

Abstract:

Schiff bases are organic compounds formed by the condensation of primary amines with carbonyl compounds, most commonly aldehydes or ketones, resulting in the formation of a characteristic imine bond. This study presents the synthesis and characterization of Schiff bases obtained by the reaction of natural aldehydes with thiocarbohydrazide. Two natural terpenoid aldehydes: citral and citronellal, were selected as starting materials because of their structure and reactivity suitable for condensation reactions. Two monosubstitued Schiff bases were synthesized by reacting thiocarbohydrazide with each aldehyde in a 1:1 molar ratio. The obtained Schiff bases were characterized by infrared (IR) spectroscopy. Comparison of the spectra of the starting materials and the synthesized compounds revealed the disappearance of characteristic absorption bands of aldehyde groups and the appearance of new bands corresponding to –C=N vibrations, confirming the success of the reaction and the formation of the desired products. This provided evidence of the structure and identity of the synthesized compounds. In our first synthesis, the reagents were citral and thiocarbohydrazide (molar ratio 1:1). As a product, (2*E*)-2-[(2*E*)-3,7-dimethylocta-2,6-dien-1-ylidene]hydrazine-1-carbothiohydrazide was obtained in a yield of 59.22%. In the second synthesis, the reagents were citronellal and thiocarbohydrazide (molar ratio 1:1), where (2*E*)-2-(3,7-dimethylocta-6-en-1-ylidene)hydrazine-1-carbothiohydrazide was obtained as a product in a yield of 52.17%.

The results confirm that the chosen method is suitable for the preparation of monosubstituted Schiff bases from natural aldehydes and thiosemicarbazide. They also highlight the importance of IR spectroscopy as a simple and reliable method for confirming the structure and identifying imine systems. This research may serve as a basis for further studies on the reactivity, biological activity and potential applications of the synthesized compounds.

Keywords:

Schiff's base, thiocarbohydrazide, citral, citronellal, IR spectroscopy

Single-core magnetite nanoparticles as dual-function agents: heat generators and Peroxymonosulfate nanocatalysts for dye degradation

Mirjana Milić[1], Miloš Ognjanović[1], Biljana Dojčinović[2], Željko Jaćimović[3], Dalibor Stanković[4], Bratislav Antić[1]

[1]VINČA Institute of Nuclear Sciences, University of Belgrade, Serbia
e-mail: bantic@vin.bg.ac.rs
[2]Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Serbia
[3] Faculty of Metallurgy and Technology, University of Montenegro, Podgorica, Montenegro
[4]Faculty of Chemistry, University of Belgrade, Serbia

Abstract:

Magnetic hyperthermia, defined as the ability of magnetic nanoparticles (MNPs) to generate heat under an alternating magnetic field, has been extensively studied for biomedical applications, particularly cancer treatment. This heat originates from relaxation and hysteresis losses, enabling efficient MNPs energy dissipation. More recently, magnetic hyperthermia has emerged as a promising approach in non-medical fields, where the generated heat can accelerate catalytic reactions and promote the activation of oxidants, opening new perspectives in advanced oxidation processes for environmental remediation. For the single-core Fe_3O_4 nanoparticles, the degradation of Reactive Black 5 (RB5) was systematically investigated under isothermal conditions. At 30 °C, conventional heating resulted in 75.6% RB5 removal after 60 min ($C/C_0 = 0.244$), while AMF-induced heating achieved a slightly lower efficiency of 69.2% ($C/C_0 = 0.308$), indicating no intrinsic enhancement of Peroxymonosulfate (PMS) activation under magnetic field conditions. The degradation efficiency strongly depended on temperature, with both heating modes showing comparable performance. At 25 °C, only ~25% degradation was observed after 45 min, whereas at 60 °C, removal increased significantly to 86.5–91.1%, confirming the dominant role of thermal activation in PMS-driven processes. Additionally, adsorption studies revealed that RB5 interaction with single-core Fe_3O_4 is pH-dependent, reaching up to ~57% removal at pH 3, while decreasing to ~12% at pH 10, highlighting the importance of electrostatic interactions between the catalyst surface and the anionic dye.

Keywords:
Nanocatalysts, Magnetic hyperthermia, MAOPs, Peroxymonosulfate, Reactive Black 5

PO1-23

Plasma Proteome Modulation and Cytokine Removal During Membrane Plasmapheresis in Post-Viral Neuroinflammation: A Case-Based Medical Chemistry Insight

Pantovic Snezana[1], Roganovic Milovan[2,1], Vojinovic Tanja[3]

[1*]Faculty of Medicine, University of Montenegro, Podgorica, Montenegro, snezap@ucg.ac.me;
[2]Clinicl for Neurology, Clinical Center of Montenegro, Podgorica, Montenegro,mil.roganovic@gmail.com
[3]Faculty of Medicine, Study Program of Pharmacy, University of Montenegro, Podgorica, Montenegro, tanjavojinovic88@gmail.com

Abstract:

Herpes simplex virus type 1 (HSV-1) encephalitis represents the most frequent cause of sporadic viral encephalitis and remains associated with considerable neurological morbidity despite timely antiviral therapy. Increasing evidence indicates that persistent neurological deficits following viral clearance are frequently driven by immune-mediated neuroinflammation rather than direct viral cytotoxicity alone. From the perspective of medical chemistry, these pathological processes involve complex biochemical disturbances including dysregulation of inflammatory cytokines, oxidative stress pathways and alterations in plasma protein composition.

This study provides a case-based biochemical insight into the role of membrane plasmapheresis as a potential therapeutic strategy in post-infectious immune-mediated HSV-1 encephalitis. A 54-year-old patient treated with standard antiviral therapy developed persistent cognitive and neurological deficits despite confirmed viral elimination. Biochemical findings indicated ongoing inflammatory activity reflected by altered plasma protein fractions, including decreased albumin and increased α-globulin levels, suggesting systemic immune activation and disruption of plasma homeostasis.

Membrane plasmapheresis was subsequently applied as an extracorporeal blood purification technique combined with laser blood irradiation and ozone therapy. From a biochemical standpoint, plasmapheresis facilitates the removal of circulating pro-inflammatory mediators such as interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), immune complexes and potentially

pathogenic autoantibodies. Adjunctive therapies may further modulate the redox balance by influencing reactive oxygen species (ROS) and improving microcirculatory oxygen delivery.

The significant clinical recovery observed within several months suggests that plasma detoxification and immunochemical rebalancing may represent promising strategies for the management of post-viral neuroinflammatory disorders. This case highlights the relevance of integrating analytical chemistry, plasma proteomics and extracorporeal blood purification technologies in the biochemical investigation of neuroimmune diseases and in the development of innovative therapeutic approaches.

Keywords:

HSV-1 encephalitis, plasmapheresis, cytokines, plasma proteomics, medical chemistry.

PO1-24

Exploration of PFAS Degradation over Ti-Supported Ti-suboxides

Tijana Milivojević[1], Maja Ranković[2], Nemanja Gavrilov[2], Anka Jevremović[2], Bojana Nedić Vasiljević[2], Danica Bajuk-Bogdanović[2], Maja Milojević-Rakić[2]
[1] Centre for Ecotoxicological Research, Podgorica, Montenegro
[2] University of Belgrade – Faculty of Physical Chemistry, Belgrade, Serbia

Abstract:

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental contaminants that present a significant challenge for conventional water treatment technologies due to their exceptional chemical stability and resistance to degradation. Among emerging approaches, electrochemical oxidation has attracted considerable attention as a versatile and environmentally compatible technique, particularly when combined with advanced electrode materials. In this work, titanium suboxide was investigated as a potential anode material for PFAS degradation. The material was synthesised hydrothermally under reducing conditions and subsequently immobilised onto a titanium mesh to obtain a stable and conductive electrode system. Structural characterisation using X-ray diffraction, Fourier transform infrared spectroscopy and Raman spectroscopy confirmed the formation of the titanium suboxide phase and indicated successful surface modification. The electrochemical performance of the prepared electrode was evaluated using selected model PFAS compounds under potentiostatic conditions. PFAS degradation was quantified by LC–MS/MS at the Centre for Ecotoxicological Research, following solid-phase extraction. The analysis confirmed efficient removal of target compounds, with degradation efficiencies exceeding 90% for PFOS and above 60% for PFOA. The applied analytical approach enabled sensitive and selective detection of PFAS at low concentration levels, providing reliable insight into degradation efficiency and supporting accurate evaluation of the treatment process. The results demonstrate effective PFAS degradation, suggesting that the prepared electrode materials represent a viable alternative to graphene or boron-doped diamond electrodes. Analysis of reactive species formation indicates the involvement of reactive oxygen species, while also pointing to the contribution of surface-mediated processes during degradation.

Keywords:
titanium suboxides, electrochemical degradation, PFAS, water treatment

Acknowledgement: This research was funded by the Science Fund of the Republic of Serbia (Grant No 17990, Advanced electrochemical treatment of PFAS contaminated water: Novel Materials and Mechanisms–ALTER).

Poster Session PO2

The assessment of potential fitoremediation purpose of selected plants in Zenica municipality, B&H

Aida Šapčanin[1,2*], Farzet Bikić [2], Gordan Jančan[3], Željko Jaćimović[4]

[1] University of Sarajevo-Faculty of Pharmacy, Sarajevo, BiH, ida@bih.net.ba
[2] University of Zenica, Faculty of Engineering and Natural Sciences, Zenica, B&H
[3] CHEMILAB d.o.o., Ljubljana Slovenia
[4] University of Montenegro, Faculty of Technology, Montenegro

Abstract:

In order to analyze the state and assess the impact to agriculture in the area of the potential local ecological network, agricultural land (locality of the city of Zenica), the soil and plant samples were analyzed for the content of heavy metals: Zn, Ni, Pb, Cd, Cr and Cu, and the valid criterion for evaluating the results was the maximum permitted concentration of selected heavy metals for agricultural land. Soil samples and selected cultivated plants were analyzed using an AAS method for the total and available content of selected heavy metals. Bioaccumulation (BAF) and translocation (TAF) factors were calculated for assessment of potential fitoremediation purpose of selected plants. The research was conducted on agricultural land plots in settlements surrounding industrial facilities in the city of Zenica, primarily those of the steel company. The results presented in this study provide a solid basis for planning soil remediation in the specified areas using phytoremediation techniques, particularly from the perspective of soil decontamination from cadmium, which has been proven feasible by the conducted research.

Keywords:

Heavy metals, plants, agricultural soil, fitoremediation.

The health risk assessment posed to heavy metals in the topsoil and plant cultivars of Zenica municipality, B&H

Aida Šapčanin[1,2]*, Farzet Bikić [2], Gordan Jančan[3], Željko Jaćimović[4]

[1] University of Sarajevo-Faculty of Pharmacy, Sarajevo, BiH, ida@bih.net.ba
[2] University of Zenica, Faculty of Engineering and Natural Sciences, Zenica, B&H
[3] CHEMILAB d.o.o., Ljubljana Slovenia
[4] University of Montenegro, Faculty of Technology, Montenegro

Abstract:

Estmating the risk to public health from heavy metals can help solve the basic questions about the potential dangers of exposure to them. This is the first study aimed to assess the health risk for the residents of the municipality of Zenica, on the land closest to the steel industry by examining the heavy metals Zn, Ni, Pb, Cd, Cr and Cu in the soil and plant cultivars corn and chard that could be used for the potential remediation of such soil. With the calculated data for HQ and HI, the non-carcinogenic and carcinogenic risk for adults and children were estimated, based on heavy metals in the selected topsoil and plants, which are usually grown in the area of interest, through different ways of their intake. The results showed that there is an unacceptable risk for children and adults due to long-term consumption of investigated plant cultivars from soil contaminated with heavy metals. Constant monitoring and measures to reducing the heavy metal pollution, primarily Cd, Pb and Cr, are necessary in the lands of the municipality of Zenica. Special caution is required for residents who intend to grow plant cultivars near steel industry.

Keywords:

Heavy metals, plant cultivars, soil, health risk assessment.

Scientific Misconduct in Chemistry and Related Areas
how to recognize it and defend

Alexander O. Chizhov

Independent Expert, 5-1 Roman Gardens, 85337 Risan, Opština Kotor, Montenegro, email: chizhov.ioc@gmail.com

Abstract:

In the first quarter of 21th century, scientific misconduct grows from separate cases of fraud to a global problem. It emerges scientific integrity and undermines a public credit to scientific community. There are areas of knowledge wholly compromised by massive fake studies production. This toxic phenomenon arises partially from a “publish or perish” concept which is a cornerstone of modern academic management based on publication and citation metrics. Some blatant examples of fraudulent publications in chemistry and related areas (biochemistry, molecular biology, material science) investigated by the author are presented and discussed.

Keywords:

Scientific misconduct, Plagiarism, Tortured phrases, Tortured brand names, Data fabrication, Authorship for sale, Citations for sale, Fake authorship and affiliations, Predatory journals

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PO2-4

Comparative Microscopy Application of Raman and FTIR Spectroscopy in the Identification of Microplastics from Sediments

Andrej Race[1], Ivan Jerman[1], Neda Bošković[2]

[1]National Institute of Chemistry, Ljubljana, Slovenia, ivan.jerman@ki.si
[2]Institute for Interdisciplinary and Multidisciplinary Studies, University of Montenegro, Podgorica, Montenegro

Abstract:

Microplastics are an emerging class of environmental pollutants, typically defined as plastic particles ranging in size from 1μm to 5.0 mm, and are increasingly detected in aquatic environments, particularly in sediments. Numerous studies have focused on their occurrence and distribution; however, reliable chemical identification of microplastics remains a significant analytical challenge.

The aim of this study is to define the key challenges and perspectives of chemical identification of microplastics extracted from rivers and lakes sediments using Raman microscopy and Fourier-transform infrared (FTIR) microscopy with attenuated total reflectance (ATR) technique in manual and automated analysis mode. The results indicate that both techniques exhibit distinct advantages and limitations. Raman spectroscopy enables the analysis of smaller microplastic particles and allows non-contact measurements; however, it is often hindered by fluorescence interference and the acquisition of low-quality spectra. In contrast, ATR-FTIR spectroscopy proves to be highly effective for the identification of larger microplastic particles, providing clearer and more reliable spectra, although direct contact between the ATR crystal and the particle may result in particle loss.

In conclusion, the combined use of multiple analytical instruments and spectroscopic approaches is recommended to achieve more accurate chemical characterization of microplastics and to improve the understanding of their composition and potential environmental impact in aquatic ecosystems.

Keywords:

Raman spectroscopy, FTIR spectroscopy, microplastics, river and lake sediments

Variability in Yield and Thymol/Carvacrol content of Hydrodistilled Essential oil from Winter Savory

Biljana Damjanović-Vratnica[1], Petar Šofranac[1], Slađana Krivokapić[2], Svetlana Perović[2]

[1] Faculty of Technology, University of Montenegro, Podgorica, Montenegro, e-mail: biljanad@ucg.ac.me
[2] Faculty of Science and Mathematics, University of Montenegro, Podgorica, Montenegro

Abstract:

In recent years, natural products, particularly aromatic herbs and their essential oils, have gained increasing attention from researchers due to their wide range of beneficial properties. Winter savory (*Satureja montana* L.), commonly known as winter savory, is a perennial small aromatic herb native to warm sunny, barren and rocky regions in the Mediterranean area. Thanks to its rich content of phytochemicals, winter savory essential oil represents a valuable basis for a wide range of industrial applications with antioxidant, antifungal, antiseptic, digestive and carminative properties. Furthermore, it is widely used in Mediterranean cuisine and increasingly applied as a natural antibacterial agent in food packaging. Winter savory essential oil is mainly characterized by oxygenated monoterpenes, such as thymol and carvacrol, whose concentrations are often considered key indicators of its antioxidant and antimicrobial activity.

The aim of this study is to examine ecological effects in different habitats in Montenegro on essential oil yield and thymol/carvacrol content in essential oil of winter savory.

Essential oil was obtained by hydrodistillation in a Clevenger-type apparatus for 2 hours (according to Yugoslav Pharmacopoeia IV) and thymol/carvacrol content was determined by GC-MS. The gained results indicate that the yield of winter savory essential oil is strongly influenced by habitat conditions as well as thymol and carvacrol content, which vary from 4,2% to 45.5% and 5.5% to 17.5%, respectively.

Keywords:

Winter savory, Hydrodestillation, Essential oil yield, Thymol, Carvacrol

PO2-6

Influence of Liposomal Encapsulation on the Antioxidant Properties of *Vaccinium myrtillus* Extract

Đura Nakarada*, Zorana Latinković, Miloš Mojović

Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia, e-mail: djura@ffh.bg.ac.rs

Abstract:

Blueberry (*Vaccinium myrtillus*) fruits represent a rich source of natural antioxidants that can neutralize reactive oxygen species and protect biological molecules from oxidative damage. In this study, the influence of extraction solvent and liposomal encapsulation on the antioxidant activity of blueberry extracts was investigated. Lyophilized blueberry fruits were subjected to ultrasound-assisted extraction using water, 50% ethanol, and pure ethanol as solvents. The antioxidant capacity of the obtained extracts was evaluated using electron paramagnetic resonance (EPR) spectroscopy toward DPPH, hydroxyl ($^{\bullet}OH$), and superoxide ($O_2^{\bullet -}$) radicals. The extract obtained in 50% ethanol exhibited the highest overall activity, showing 50.17% scavenging of DPPH radicals and neutralization of 82.09% of hydroxyl radicals and 36.03% of superoxide radical anions. This extract was selected for liposomal encapsulation. Liposomes were prepared using hydrogenated lecithin by the thin-film hydration method followed by ultrasonic dispersion. The antioxidant activity of the encapsulated extract was then compared with that of the free extract. After encapsulation, the DPPH scavenging activity remained largely preserved (47.86%), while the activity toward hydroxyl and superoxide radicals decreased to 68.27% and 17.31%, respectively. These changes may be attributed to altered accessibility of antioxidant compounds after incorporation into the liposomal structure. The obtained results demonstrate that solvent polarity plays a crucial role in the extraction of blueberry antioxidants and that liposomal encapsulation can preserve or modulate their antiradical activity. Such systems represent promising carriers for natural antioxidant compounds with potential applications in pharmaceutical and cosmetic formulations.

Keywords:

Vaccinium myrtillus, EPR, Antioxidants, Free radicals

PO2-7

Liposomal Delivery of *Inonotus obliquus* Extract in a Dermocosmetic Cream: Antioxidant Activity and Penetration Studied by EPR

Đura Nakarada[1]*, Nevena Preradović[2], Miloš Mojović[1]

[1]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia, e-mail: djura@ffh.bg.ac.rs
[2]Institute for Multidisciplinary Research, University of Belgrade, Belgrade, Serbia

Abstract:

Natural fungal extracts are increasingly explored as sources of bioactive compounds for dermocosmetic formulations. In this study, an extract of the medicinal mushroom *Inonotus obliquus* (chaga) was incorporated into liposomes, added into a cream, and its antioxidant activity and penetration potential were evaluated using electron paramagnetic resonance (EPR) spectroscopy and imaging. Chaga extracts were obtained by ultrasound-assisted extraction using water, 50% ethanol, and 70% ethanol. The 50% ethanol extract demonstrated very high scavenging activity toward DPPH and hydroxyl radicals (98.4% and 92.7%, respectively). Liposomes containing this extract were prepared using a thin-film hydration method combined with sonication, with lecithin as the phospholipid component. The resulting liposomal dispersion was incorporated into an oil-in-water cream base developed in our laboratory. This formulation exhibited moderate activity toward DPPH radicals (33.4%) but showed very high scavenging efficiency toward hydroxyl radicals (92.5%). The results indicate that chaga-derived compounds remain functionally active after liposomal encapsulation and incorporation into the cream matrix. Penetration properties were evaluated using 2D EPR imaging in a gelatin-based skin model. The formulation produced deep signal distribution indicating enhanced diffusion through the matrix. These findings demonstrate that liposomal delivery enables effective incorporation of *Inonotus obliquus* extract into dermocosmetic formulations while preserving strong antioxidant activity and promoting penetration through model skin layers.

Keywords:

Chaga, EPR, Dermocosmetics, Antioxidants, Free radicals

Possibilities of using Electrical and electronic waste

J. Šćepanović [1], M. Milićević [2], D. Radonjić [1], D. Vuksanović [1],

[1] Faculty of Metallurgy and Technology, Podgorica, Montenegro, e-mail: jelenapj@ucg.ac.me

[2] Airports of Montenegro

Abstract:

One of the basic characteristics of electrical and electronic waste is its marked heterogeneity. Unlike other waste streams, e-waste is a complex mixture of metals, plastics, glass, ceramics and various composte materials. The composition of e-waste varies significantly depending on the type of device, the year of production and the level of technological development, which further complicates its sorting and processing. It is this diversity that makes e-waste technically demanding to manage, but at the same time extremely valuable in terms of the possibility of using secondary raw materials. In addition to negative effects on the environment, electrical and electronic waste has serious consequences for human health. Exposure to hazardous substances present in e-waste can lead to acute and chronic health problems. Lead is known for its neurotoxic effect, especially in children, where it can cause a decrease in cognitive abilities and developmental disorders. Mercury affects the central nervous system, while cadmium can cause kidney and bone damage.

People who are directly involved in the collection and processing of electronic waste, especially in informal sectors without appropriate protective equipment, are particularly at risk. Children and pregnant women are particularly sensitive groups when it comes to exposure to pollutants from electronic waste.

The goal of the work is to review the possibilities of using electrical and electronic waste, through the presentation of the theoretical foundations of e-waste management, modern methods of processing and recycling, as well as the analysis of the practical application of these principles on the example of the electronic waste management system in Montenegro.

Key words: Electrical and electronic waste, hazardous substances, environment

PO2-9

Electrochemical sensor for zinc monitoring in mining-impacted waters

Katarina Laketić[1]*, Bojana Knežević Vulićević[1], Ivana Bulatović[1], Serena Laschi[2], Ilaria Palchetti[2]

[1]Center for Ecotoxicological Research, Podgorica, Montenegro,
e-mail: katarina.laketic@ceti.me
[2]Department of Chemistry Ugo Schiff, University of Florence, Florence, Italy

Zinc is an essential trace element that plays an important role in numerous biochemical and metabolic processes in plants, animals, and microorganisms. In natural waters, zinc usually occurs at low concentrations due to the limited solubility of its carbonates, oxides, and sulfides. However, anthropogenic activities such as mining, together with natural processes such as the oxidation of sulfide minerals when exposed to atmospheric conditions, can significantly increase zinc concentrations in aquatic ecosystems. Although zinc is required in small amounts for biological functions, elevated concentrations may negatively affect water quality and aquatic organisms, making monitoring important for environmental protection. In this study, the iMERMAID solution based on electrochemical sensor technology was tested for determining zinc concentrations in water samples. The research was conducted in the former Brskovo mine, characterized by a complex aquatic environment with elevated metal concentrations, acidic conditions, and variable hydrological regimes. These characteristics make the site particularly suitable for testing sensor technologies under real environmental conditions, especially in highly contaminated waters originating from an open-pit lead and zinc mining area. Validation of the electrochemical method was performed through parallel monitoring with ICP-MS analyses during seven sampling campaigns conducted between October 2025 and February 2026. In all samples, total and dissolved zinc concentrations were determined using the ICP-MS method, while the electrochemical sensor was used for the determination of dissolved and zinc concentrations in unfiltered samples. The results showed zinc concentrations ranging from <1 mg/L to >39 mg/L. Due to high electrical conductivity (>1500 µS/cm) and strongly acidic conditions (pH ≈ 3), multiple sample dilutions were required prior to analysis. Comparison with ICP-MS results showed good agreement, with relative differences below 30% in most cases. The obtained results confirm the applicability of the electrochemical sensor in complex water matrices and indicate its potential for field monitoring of zinc and broader applications in environmental monitoring and protection.

Keywords:

Zinc, iMERMAID solution, Electrochemical sensor, ICP-MS, Water monitoring

PO2-10

Risk assessment of acrylamide in potato chips in Montenegro

Luka Andrić[1,2], Amil Orahovac[2], Dijana Đurović[1,2]

[1]Center for Ecotoxicological Research, Podgorica, Montenegro,
[2]Faculty for Food Technology, food Safety and Ecology, UDG, Montenegro

Abstract

Health risks from dietary acrylamide consumption, specifically from chips consumed in Montenegro was assessed in potato chips from the Montenegrin market. Dietary exposure and cancer related risk in 94 samples collected 2023–2026, were estimated using EFSA's BMDL10 (0.17 mg/kg bw/day) and the margin of exposure (MOE) approach. All samples were analysed in an accredited laboratory (Center for Ecotoxicological Research in Podgorica) following the international standard MEST EN 16618:2016, "Food analysis - Determination of acrylamide in food by liquid chromatography tandem mass spectrometry (LC-ESI-MS/MS). Two scenarios were modelled: best case (non compliant lots excluded; n=62; mean 341 µg/kg) and worst case (all samples; n=94; mean 671 µg/kg; 34% >750 µg/kg). Using Montenegro specific consumption and bodyweight data, EDIs from potato chips alone yielded MOEs below the EFSA 10,000 benchmark for children, adolescents and some young adults in both scenarios (e.g., children 10–14y: MOE ≈4 885 best, ≈2 483 worst), indicating potential public health concern. Major sources of uncertainty include analytical variability (±12.5%), left censoring of <LOQ results (LOQ ≈50 µg/kg treated as zero), market heterogeneity, and limitations of single food exposure assessment. Findings support targeted surveillance and enforcement for high acrylamide lots, industry mitigation measures, expanded probabilistic and aggregate dietary exposure assessment, and consideration of biomonitoring in vulnerable groups to validate internal dose estimate.

Keywords:

Acrylamide, potato chips, risk assessment

Analitical Concordance Between KFLC Index And Isoelectric Focusing of Cereborspinal Fluid and Serum In Patients With Multiple Sclerosis: Experience From Montenegro

Milovan Roganovic[1,2,*], Tanja Antunovic[3], Balsa Vujovic[1,2], Sandra Vujovic[1], Ljiljana Radulovic[1,2], Mladen Debeljevic[1], Slavisa Perunicic[1], Zilha Idrizovic[1], Jevto Erakovic[1], Dragica Milikic[1], Ivana Bulatovic[1]

[1]Clinic for Neurology, Clinical Center of Montenegro, Podgorica, Montenegro
[2]Faculty of Medicine, University of Montenegro, Podgorica, Montenegro
[3]Center for clinic-laboratory diagnostic, Clinical Center of Montenegro, Podgorica, Montenegro

Abstract:

Multiple sclerosis (MS) is a chronic inflammatory demyelinating disease of the central nervous system whose diagnosis requires integration of clinical, radiological, and laboratory findings and exclusion of alternative diagnoses. Cerebrospinal fluid (CSF)-restricted oligoclonal IgG bands detected by isoelectric focusing (IEF) remain a reference marker of intrathecal immunoglobulin synthesis, while the kappa free light chain (KFLC) index has emerged as a rapid, quantitative complementary biomarker. Published studies report an agreement of about 90% between IEF and KFLC findings. This study assessed the concordance between these methods in patients with definite MS from Montenegro. This retrospective single-center study included 22 patients diagnosed with definite MS between April 2025 and February 2026. Seventeen patients were women (77.3%), and the mean age was 37.0±12.4 years. For oligoclonal band detection, paired CSF and serum samples were subjected to isoelectric focusing in alkaline pH gradient, followed by immunofixation for IgG visualization and pattern interpretation. KFLC and albumin concentrations in CSF and serum were measured by immunochemical methods, including immunonephelometry and/or immunoturbidimetry, and the KFLC index was calculated according to formula: (CSF KFLC/serum KFLC)/(CSF albumin/serum albumin). A KFLC index ≥ 6.1 was considered positive, while IEF findings supportive of MS were defined as type 2 or type 3 patterns. IEF findings supportive of MS were present in 20/22 patients (90.9%), and a KFLC index ≥ 6.1 was also found in 20/22 patients (90.9%). The mean KFLC index was 58.8±64.3 (range 1.1-234.4). Concordance between IEF and KFLC results was observed in 18/22 patients (81.8%), with discordant findings in 4/22 (18.2%). These findings confirm the high diagnostic value of both methods and support their complementary use in routine MS diagnostics.

Keywords:
multiple sclerosis, cerebrospinal fluid, oligoclonal bands, kappa free light chains, concordance

The effect of potato pretreatment on acrylamide formation in French fries during frying

Mara Kandić[1], Biljana Damjanović-Vratnica[2], Dijana Đurović[3]

[1]Faculty of Technology, University of Montenegro, Podgorica,
Montenegro, e-mail: marakandic@ucg.ac.me
[2]Faculty of Technology, University of Montenegro, Podgorica,
Montenegro
[3]Faculty for Food Technology, Food Safety and Ecology,
University Donja Gorica, Podgorica, Montenegro

Abstract:

Acrylamide is an organic compound that is formed during the thermal processing of carbohydrate-rich foods in the reaction between reducing sugars and the amino acid asparagine. Due to its association with neurotoxic and genotoxic effects in animals, it is a significant subject of research. The main dietary sources of acrylamide include bread and baked goods, coffee and thermally processed potato products such as French fries and potato chips.

This study investigated the impact of potato pretreatment (soaking in water for 10 minutes and freezing for 24 h) on acrylamide formation in French fries during deep frying in sunflower oil, and also assessed the effect of multiple oil reuse on acrylamide content.

Liquid chromatography coupled with mass spectrometry (LC-MS/MS) was used to determine acrylamide content in French fries. It was found that acrylamide content depends on the applied pretreatments of potatoes, which is related to the content of reducing sugars. Pretreatment by soaking in water resulted in lower acrylamide content, while pretreatment by freezing led to its increase. Reuse of frying sunflower oil led to an increase in the acrylamide content of the French fries regardless of the pretreatment applied. Obtained results indicate that the application of appropriate pretreatments of the potato can contribute to the reduction of the acrylamide content in the French fries.

Keywords:

Acrylamide, French fries, Potato pretreatment, Oil reuse, Reducing sugars

PO2-13

Development and Environmental Biodegradation of Starch-Based Bioplastics

Marija Kaluđerović[1], Miljan Bigović[1], Jovana Micev[2], Ana Rakočević[3]

[1]Faculty of Natural Sciences and Mathematics, Podgorica, Montenegro, e-mail: marija.ka@ucg.ac.me
[2]Institute for medicines and medical devices, Podgorica, Montenegro

[3]Nativa professional, Podgorica

This study investigates the preparation of starch-based bioplastics and their biodegradation as sustainable alternatives to conventional plastics. Starch extracted from potatoes was used to synthesize bioplastic films via gelatinization in water with glycerol as a plasticizer and acetic acid as a catalyst. Four formulations with different compositions were prepared to examine the influence of glycerol, starch, and water content on mechanical properties and biodegradability. The films exhibited varying characteristics, from brittle to highly elastic, depending mainly on glycerol content. Biodegradation was evaluated in soil (25 °C) and distilled water (10 °C) by monitoring mass changes. In soil, bioplastic samples lost 40–50% of their mass within 28 days (Figure 1) and completely degraded after 38 days, while polypropylene (PP) and PET showed no degradation. In distilled water, only limited degradation occurred, with starch release detected only after heating. These findings demonstrate that starch-based bioplastics offer tunable mechanical properties and controllable biodegradation rates, highlighting their potential for sustainable packaging applications.

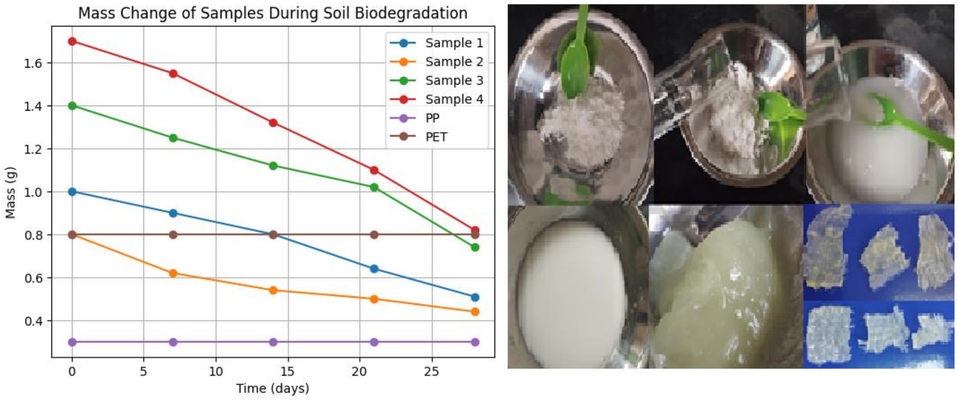

Figure 1. Schematic representation of the bioplastic synthesis process and mass change of samples during soil biodegradation over 28 days

Keywords: Bioplastics, starch, biodegradation, sustainable packaging

Occurrence and distribution of estrogenic compounds in the Skadar Lake basin

Anja Babić[1], Vladimir Živković[1], Marko Nikolić[1], Bojana Knežević[1], Miljan Bigović[2]

[1]Center for Ecotoxicological Research Podgorica, Montenegro, e-mail: anja.babic@ceti.me

[2] Faculty of Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro

Abstract:

Endocrine disrupting chemicals (EDCs), including hormones and bisphenol A (BPA), are emerging contaminants that can disrupt hormonal regulation in aquatic organisms even at very low concentrations. Among these, steroid estrogens and BPA are of particular concern because of their strong estrogenic activity, yet information on their occurrence in the Skadar Lake basin remains limited. To address this gap, this study investigated the presence of selected estrogenic compounds estrone, 17β-estradiol, 17α-ethinylestradiol and BPA in surface waters of Skadar Lake and its main tributary, Morača River. During four sampling campaigns 44 water samples were collected from seven sites in Skadar Lake and four sites along the Morača River. Water samples were extracted using an automated solid-phase extraction (SPE) system, followed by derivatization with trimethylsilyl imidazole and determination by gas chromatography coupled with tandem mass spectrometry (GC–MS/MS). Estrone (E1) was the most frequently detected compound, occurring in 95% of the analyzed samples with concentrations ranging from 0.01 to 0.76 ng/L. 17β-estradiol (E2) was detected in 50% of the samples, with concentrations between 0.01 and 0.24 ng/L. 17α-ethinylestradiol (EE2) was quantified at two sampling sites in Skadar Lake during the summer sampling campaign, with concentrations ranging from 0.05 to 0.18 ng/L. Bisphenol A was detected in 80% of the samples, with concentrations ranging from 0.5 to 36 ng/L. Environmental risk evaluation using predicted no-effect concentrations (PNEC) showed estrone exceeded the 0.36 ng/L threshold in four samples from Morača River. 17β-estradiol exceeded PNEC in only one sample. 17α-ethinylestradiol surpassed PNEC values six to tenfold at two lake sampling sites. A clear variability in concentrations was observed among the different sampling campaigns, suggesting that the occurrence and distribution of these compounds are influenced by temporal factors such as seasonal changes in hydrological conditions, variations in wastewater discharge, and differences in human activity throughout the year.

Keywords:

Endocrine disrupting chemicals, Skadar Lake Basin, Estrone, 17β-estradiol, Bisphenol A, Predicted no-effect concentration

Mechanistic insight into arsenic binding and selectivity of UiO-66-NH_2 in real groundwater

Mirjana Milić[1], Biljana Dojčinović[2], Željko Jaćimović[3], Sladjana Novaković[1], Milada S. Novaković[4], Bratislav Antić[1]

[1]VINČA Institute of Nuclear Sciences, University of Belgrade, Serbia
e-mail: biljana.matic@ihtm.bg.ac.rs
[2]Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Serbia
[3] Faculty of Metallurgy and Technology, University of Montenegro, Podgorica, Montenegro
[4]Technical College of Applied Sciences in Zrenjanin, Serbia

Abstract:

Arsenic contamination of groundwater represents a critical global environmental and public health challenge, affecting millions of people exposed to concentrations above the WHO guideline limit of 10 µg/L. The development of efficient, selective, and practically applicable materials capable of operating under complex hydrochemical conditions remains a major scientific and technological priority. In this study, a defect-enriched amino-functionalized zirconium-based metal–organic framework, UiO-66-NH_2, was applied directly to naturally contaminated groundwater. At a low dosage (0.5 g/L), the material rapidly reduced arsenic concentration from ~227 µg/L to below the regulatory limit within 15 minutes at natural pH, while simultaneously suppressing competing phosphate species and preserving the majority of essential dissolved minerals. The system exhibited pronounced selectivity toward arsenic, with minimal impact on water composition, demonstrating its suitability for realistic water treatment scenarios. Mechanistic investigations combining DFT calculations and FT-IR spectroscopy reveal that arsenic immobilization is governed by a multi-step process, dominated by inner-sphere coordination between arsenic species and defect-exposed Zr–OH sites, forming stable Zr–O–As bonds. Electrostatic interactions and hydrogen bonding facilitated by –NH_2 functional groups contribute to initial adsorption and pre-orientation of arsenic species within the MOF structure. This synergy between defect engineering and functionalization enables high affinity toward both As(III) and As(V) species, while simultaneously ensuring selectivity in the presence of competing ions.

Keywords: Arsenic removal, Metal–organic frameworks (MOFs), Groundwater treatment, Selective adsorption, Inner-sphere complexation

PO2-16

From Nut Shell Waste to Dye Adsorbents: The Effect of Cationic Dye Structure on Removal Efficacy

Naji Agilee[1], Milica Delić[1], Đorđe Ogrizović[1], Tijana Spasojević[2], Nevena Prlainović[1*], Maja Đolić[1]

[1]Faculty of Technology and Metallurgy, University of Belgrade, Serbia, *nprlainovic@tmf.bg.ac.rs
[2]Innovation Center of Faculty of Technology and Metallurgy, University of Belgrade, Serbia

Abstract:

Agro-waste-derived lignocellulosic materials have attracted increasing attention as low-cost and sustainable adsorbents for wastewater treatment. In this study, raw hazelnut (RH) and raw walnut (RW) shell were evaluated as biosorbents for the removal of cationic dyes, with particular emphasis on the role of organic structure onto the adsorption behavior. The present work compares the adsorption of Basic Red 18 (BR18) and malachite green (MG) on the RH, and further on investigates the adsorption of malachite green on RW shells. The results showed that BR18 exhibited faster initial uptake on the RH shell, whereas MG reached higher final adsorption capacities. The observed behavior was attributed to the compact triphenylmethane structure of MG; its greater hydrophobicity, and its stronger π–π interactions with the aromatic lignin domains of the lignocellulosic matrix. This interpretation was supported by kinetic analysis, which indicated that the adsorption process is generally better described by the pseudo-second-order model. Weber–Morris and Boyd analyses confirmed a multistep mechanism involving both external mass transfer and intraparticle diffusion. The equilibrium adsorption capacities for MG increased with increasing initial concentration, reaching approximately 10.1, 25.7, and 41.2 mg/g on RH shell and 14.2, 26.5, and 46.4 mg/g on RW shell at initial concentrations of 50, 100, and 200 mg/L, respectively. Isotherm analysis further revealed that malachite green adsorption on raw walnut shell could be satisfactorily described by Freundlich and Temkin models, whereas the poorer fit obtained for raw hazelnut shell suggested a more heterogeneous adsorption surface and a more complex binding mechanism. Overall, the study demonstrates that both nut shells are promising agro-waste adsorbents for cationic dye removal, while MG emerges as a more suitable model dye for further investigation of structure–adsorption relationships and the influence of lignocellulosic adsorbent type on wastewater treatment performance.

Keywords:

hazelnut shell, walnut shell, cationic dye, agro-waste, molecular structure

Anthropogenic Pressure Reflected in Microplastic Loads: Evidence from the Sitnica River

Neda Bošković[1], Andrej Race[2], Ivan Jerman[2], Željko Jaćimović[3]

[1]Institute for Interdisciplinary and Multidisciplinary Studies, University of Montenegro, Podgorica, Montenegro, nedaboskovic93@gmail.com
[2]National Institute of Chemistry, Ljubljana, Slovenia
[3]Faculty of Metallurgy and Technology, University of Montenegro, Podgorica, Montenegro

Abstract:

Microplastic (MP) pollution is an emerging environmental concern in freshwater ecosystems, including small river systems that act as long-term sinks for anthropogenic contaminants. This study investigated the occurrence, spatial distribution, and ecological risk of MP in shore sediments of the Sitnica River, a small tributary of the Morača River, with the aim of providing baseline information for future monitoring and management strategies. Sediment samples were collected from four representative sites along the river, covering the river source, areas influenced by human settlements, and the confluence with downstream water bodies. Samples were analyzed for MP abundance, size distribution, shape, color, and polymer composition using standardized laboratory methods. Spatial analysis revealed that MP concentrations decreased in the order S2 > S3 > S4 > S1, reflecting the progressive influence of human activities along the river course. Fragmented particles were the dominant MP shape across all sites, and smaller-sized microplastics were most prevalent, suggesting enhanced fragmentation and transport processes in the sedimentary environment. Variations in MP color were observed among sites, while polypropylene was identified as the most abundant polymer. Ecological risk assessment using the Pollution Load Index classified the sediments as slightly contaminated, indicating relatively low overall MP abundance. In contrast, the Polymer Hazard Index highlighted a very high ecological hazard due to the presence of hazardous polymers such as polyamide and polystyrene. These findings demonstrate that even small tributaries like the Sitnica River can accumulate MP with potentially high environmental impact and underscore the importance of including polymer-specific hazard assessments in freshwater monitoring programs to support informed management and mitigation strategies.

Keywords:

Microplastic pollution, small tributary; riverine sediments, ecological risk

Hidden Pollutants in a Protected Alpine Environment: Microplastic Contamination of Vražje Lake, Durmitor National Park

Neda Bošković[1], Željko Jaćimović[2], Andrej Race[3], Ivan Jerman[3]

[1]Institute for Interdisciplinary and Multidisciplinary Studies, University of Montenegro, Podgorica, Montenegro, nedaboskovic93@gmail.com
[2]Faculty of Metallurgy and Technology, University of Montenegro, Podgorica, Montenegro
[3]National Institute of Chemistry, Ljubljana, Slovenia

Abstract:

Nestled within the high-altitude landscapes of Durmitor National Park, Vražje Lake is a glacial lake characterized by its pristine waters, minimal human disturbance, and unique alpine ecosystem. Despite its apparent isolation, this study revealed the presence of microplastic (MP) particles in surface sediments, highlighting the susceptibility of even remote freshwater systems to anthropogenic pollutants. Sediment samples were collected along multiple shoreline sites during two sampling periods and analyzed using density separation, visual identification, and polymer characterization. MP concentrations varied among locations and sampling periods, reflecting spatial heterogeneity and seasonal influences. Fragments and fibers dominated the MP assemblage, with most particles in the 1–3 mm size range. Blue-colored particles were most prevalent, and polyethylene was the dominant polymer, accompanied by other polymers associated with potential chemical hazards. Pollution Load Index (PLI) values suggested relatively low contamination levels; however, polymer hazard assessments indicated a high ecological risk, demonstrating that specific polymer types can pose significant threats even in lakes with low overall MP abundance. The spatial distribution of MPs appeared linked to limited human activity, such as recreational access points, while long-range transport may also contribute to contamination. These findings underscore that glacial lakes in protected alpine areas, despite their seclusion, are not immune to microplastic pollution. The results provide essential baseline data for alpine freshwater ecosystems and highlight the need to incorporate polymer-specific hazard assessments into conservation and management strategies aimed at preserving high-altitude lake environments.

Keywords:

Microplastics, glacial lake, risk assessment, Durmitor National Park

PO2-19

Green NADES-based extraction of apple peel bioactives: a sustainable source of antioxidants and tyrosinase inhibitors

Nevena Kićović[1], Jelena Trifković[1], Filip Andrić[1], Miljan Bigović[2], Dragana Dabić[3], **Marija Kaludjerović**[2], Petar Ristivojević[1*]

[1]Department of Analytical Chemistry, University of Belgrade-Faculty of Chemistry, Studentski trg 12-16, 11158 Belgrade, Serbia, [*]email: ristivojevic@chem.bg.ac.rs
[2]Faculty of Natural Sciences and Mathematics, University of Montenegro, Džordža Vašingtona bb, Podgorica, Montenegro
[3]Innovation Centre of Faculty of Chemistry Ltd., Studentski Trg 12-16, 11158 Belgrade, Serbia

Abstract:

Apple is one of the most widely cultivated fruit crops, while its peel, often discarded as agro-industrial waste, represents a rich source of polyphenols. Growing interest in circular-economy approaches has driven the exploration of fruit by-products as functional ingredients with potential application in food and cosmetics industry. This study explores the valorization of apple peel using green extraction, applying eight betaine-based Natural Deep Eutectic Solvents (NADES) to recover bioactive-rich extracts for potential industrial use. Ethanol and methanol were used as conventional solvents to compare extraction efficiency. Obtained green extracts were evaluated using three assays such as total phenolic content (TPC), antioxidant activity (DPPH assay), and tyrosinase inhibitory potential. Results demonstrated that betaine-based NADES efficiently enhanced the extraction of phenolic compounds compared to conventional solvents. The highest TPC was observed for extract E5 (9.68 ± 0.15 mg GAE/g), while the highest antioxidant activity was recorded for extract E7 (27.56 ± 1.18 μmol TE/g). In contrast, ethanol and methanol extracts displayed significantly lower activity. Additionally, the most pronounced tyrosinase inhibition was observed for extract E2 (66 ± 4%), indicating potential applications in cosmetic formulations targeting skin hyperpigmentation, as well as in food systems to prevent enzymatic browning. Apple peel is a sustainable source of antioxidants and enzyme inhibitors, with NADES enabling green extraction for food and cosmetic applications.

Keywords:
Apple peel, Circular economy, NADES, Antioxidative assay, and tyrosinase inhibitory potential.

Acknowledgments
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PO2-20

Antioxidant Capacity of fresh chokeberry fruit (*Aronia melanocarpa*) from Montenegro

Sanja Blagojević, Snežana Brašanac-Vukanović, Jana Jočić, Nada Blagojević, Vesna Vukašinović-Pešić,

University of Montenegro, Faculty of Metallurgy and Technology, Džordža Vašingtona bb.,

81000 Podgorica, Montenegro, *e-mail:* sanjablagojevicsa@gmail.com

Abstract:

The aim of this study was to spectrophotometrically investigate the antioxidant properties and total phenolic compounds in fresh chokeberry fruit (*Aronia melanocarpa*) with consideration of the influence of the geographical origin (Plužine, Pavino Polje, Plav, Berane) of the sample. The total content of polyphenols was quantified, while antioxidant activity was determined using the DPPH and FRAP methods. In parallel, the relationship with microelements (Mn, Fe, Cu, Zn) was examined, and the results were statistically processed.

In fresh fruit, the total phenolic content ranged from 100.63 to 2055.22 mg GAE/100 g sample, flavonoids from 109.28 to 266.65 mg Qc/100 g, anthocyanins from 0.2361 to 0.5013%, tannins from 0.091 to 1.1462%, while antioxidant activity values determined by the DPPH test (IC_{50}) were 0.002182–0.0292 μg/mL, and for the FRAP test 0.1369–0.4183 μmol Fe^{2+}/g.

It was shown that the samples from Plužine had the highest content of total phenols and anthocyanins, while the highest content of flavonoids was found in the chokeberry samples from Plav. The tannin content was highest in the samples from Pavino Polje.

The DPPH method determined that the samples from Plužine had the highest antioxidant potential. On the other hand, the FRAP method determined the highest values of reducing capacity for the samples from Pavino Polje.

The analysis of metal content in fresh fruit showed that Zn ranged from 2.935 to 3.708 μg/g, Fe from 2.968 to 5.729 μg/g, Cu from 0.491 to 0.841 μg/g, and Mn from 1.857 to 4.332 μg/g. Statistically analysis showed that the locality significantly influenced the content of all tested parameters.

Correlation of metals with antioxidant activity shows that Zn has a positive correlation with FRAP values (Rs = 0.870), which may indicate a potential role of zinc as a cofactor of oxidative enzymes. In contrast, Cu and Fe show a negative correlation with antioxidant activity obtained by DPPH assay.

Keywords:

Chokeberry, Polyphenols, DPPH, FRAP, Metals

PO2-21

Spectrophotometric determination of polyphenols in extracts of chokeberry fruit (*Aronia melanocarpa*) from Montenegro

Sanja Blagojević, Snežana Brašanac-Vukanović, Jana Jočić, Vesna Vukašinović-Pešić, Nada Blagojević

University of Montenegro, Faculty of Metallurgy and Technology, Džordža Vašingtona bb., 81000 Podgorica, Montenegro, *e-mail:* sanjablagojevicsa@gmail.com

Abstract:

In this work, extracts of chokeberry fruit (*Aronia melanocarpa*) from different area of Montenegro were examined. Several types of extraction were performed: Soxhlet, maceration, hot water extraction (infusion) and ultrasonic extraction. Total phenols, flavonoids, anthocyanins, tannins, antioxidant activity using the DPPH and FRAP methods, essential metals such as zinc, manganese, copper and iron were determined in the extracts. The results were statistically processed (ANOVA, Pearson correlation).

In chokeberry extracts, the highest phenolic content was recorded in ultrasonic extracts (1599.28–2056.99 mg GAE/100 g), while infusion extracts contained the highest amounts of flavonoids (2351.3–4186.2 mg Qc/100 g) and tannins (7.895–12.011%). The lowest IC_{50} values obtained by the DPPH method, indicating the strongest antioxidant activity, were observed in macerates (0.000315–0.0321 µg/mL). FRAP values varied depending on the extraction method, with the highest values recorded in hot water extracts (20.0677 µmol Fe^{2+}/g).

Microelement concentrations in extracts varied: Fe 0.251–1.564 µg/g, Zn 0.759–5.704 µg/g, Cu 0.2164–3.736 µg/g, and Mn 0.528–8.739 µg/g.

One-way ANOVA analysis showed that both the locality and the extraction method significantly influenced the content of all tested parameters. The Friedman test confirmed statistically significant differences among extraction methods for all parameters. Using the same method, hot water extraction, the highest value was determined for flavonoids (3165.64) and the lowest value for anthocyanins (0.36). The highest contents of Zn, Cu, and Mn were obtained by hot water extraction. Spearman correlation analysis revealed a strong positive correlation of phenols, flavonoids, and tannins with FRAP values, while the DPPH test showed a negative correlation with IC_{50} values, confirming that phenolic compounds are the main contributors to the antioxidant potential of chokeberry extracts.

Keywords:

Chokeberry, Extract, Phenols, Flavonoids, Anthocyanins, Tannins, DPPH, FRAP, Metals

Incorporation of flotation tailing from mining of Pb and Zn into fly ash-based geopolymers: Evaluation of the leaching protocol

Sara Lukovac[1], Nebojša Tadić[2], Dijana Đurović[3], Irena Nikolić[2]

[1] Institute for interdisciplinary and multidisciplinary studies, University of Montenegro, Cetinjska br. 2, Podgorica, Montenegro, e-mail: sara.lukovac@edu.ucg.ac.me
[2] Faculty of Metallurgy and Technology, University of Montenegro, Džordža Vašingtona bb, Podgorica, Montenegro
[3] Centre for Ecotoxicological Research, Bulevar Šarla De Gola 2, Podgorica, Montenegro

Abstract:

Flotation tailing (FT) is mineral processing waste produced during mining activities in lead and zinc ores. This waste present potential environmental hazard due to the potential leaching of heavy metals. In order to minimize environmental impact, the safe incorporation of flotation tailing into the building materials can be of great importance. This paper investigated possibility of synthesis of new eco-friendly fly ash (FA) based building materials known as fly ash based geopolymers with incorporation of flotation tailing from the lead and zinc mine Šuplja Stijena in Pljevlja (Montenegro). This approach offers sustainable approach for flotation tailing that will reduce toxicity of tailing or convert it into product that can be safely used in a civil engineering or disposed at landfills. This approach also offer solution for fly ash (the waste material from coal combustion in a thermal plants) utilization which is currently dispose of at landfill. Fly ash based geopolymers were synthesized under defined experimental conditions: S/L ratio of 1, Na_2SiO_3/NaOH mass ratio of 1.5, 10M NaOH, and different percentage of fly ash replacement with a flotation tailing (1% to 10%). Toxicity characteristic leaching procedure (TCLP) was carried out in order to evaluate the mobility of heavy metals from raw FT and FA-based geopolymers containing different proportion of flotation tailing. The results of leaching TCLP test indicate the hazardous nature of flotation tailing since concentration of lead (50.55 mg/L) exceeded regulatory level (5 mg/L) for TCLP procedure. On the other hand, TCLP leachates of FA-based geopolymers containing different proportion of flotation tailing (1-10%) indicated the safe incorporation of FT into the FA based geopolymers since the results TCLP tests of geopolymers were below regulatory levels.

Keywords:

Flotation tailing from mining of Pb and Zn, TCLP leaching test, fly ash, geopolymers

PO2-23

Mercury in Fish and Seafood on the Montenegrin Market: Analytical Monitoring and Relevance for Public Health and Tourism

Vojinovic T [1], Pantovic S [2], Delevic M [3-1], Hadzibeti Dj[1], Roganovic M [4-2]

[1] Faculty of Medicine, Study Program of Pharmacy, University of Montenegro, Podgorica, Montenegro, tanjavojinovic88@gmail.com
[2]*Faculty of Medicine, University of Montenegro, Podgorica, Montenegro, snezap@ucg.ac.me
3 Institute for Public Health of Montenegro, Podgorica, Montenegro, mitar.delevic@ijzcg.me
[4]Clinicl for Neurology, Clinical Center of Montenegro, Podgorica, Montenegro, mil.roganovic@gmail.com

Abstract: Fish and seafood are widely recognized as nutritionally valuable foods due to their high content of high-quality proteins, omega-3 fatty acids and essential micronutrients. However, they may also represent a potential source of exposure to toxic metals, particularly mercury, which is known for its neurotoxic and cardiotoxic effects. Mercury contamination of aquatic ecosystems is a global environmental and public health concern because mercury can be transported over long distances in the atmosphere and subsequently accumulate in aquatic organisms through bioaccumulation and biomagnification processes. The aim of this study was to determine the concentration of mercury in fish and fish products available on the Montenegrin market and to assess possible implications for food safety and human health. Thirteen samples of fresh fish and fish products obtained during regular phytosanitary monitoring were analysed at the Institute of Public Health of Montenegro using a Direct Mercury Analyzer (DMA-80). Samples were analysed both as homogenized solid samples and as liquid samples obtained after microwave digestion with nitric acid and hydrogen peroxide in order to compare analytical approaches. Blank analysis confirmed the reliability of the analytical method, with mercury concentrations below 0.0005 µg/kg. The results showed measurable mercury concentrations in all analysed marine fish samples. The highest concentration was detected in canned tuna, followed by fresh cod and frozen hake, while lower concentrations were observed in perch, sea bass and trout. Mercury levels in fish are influenced by species, age, diet, environmental conditions and technological processing. Although the detected concentrations were generally low and below European regulatory limits, continuous monitoring remains essential. This is particularly important for Montenegro as a Mediterranean tourist destination where seafood consumption significantly increases during the tourist season and where a substantial proportion of fish products are imported.

Keywords: mercury, fish products, toxic metals, food safety, public health.

Assessment of Acrylamide Exposure and Associated Health Risk from Potato Chips Consumption in Montenegro

Tijana Milivojević[1], Filip Bošković[1], Bojana Mugoša[1], Olivera Gogić[1], Majda Nikočević[1],
[1]Centre for Ecotoxicological Research, Podgorica, Montenegro, e-mail:
tijana.milivojevic@ceti.me

Abstract:

Health risks associated with dietary acrylamide intake, particularly from potato chips consumed in Montenegro, were assessed using the Margin of Exposure (MOE) approach. Acrylamide is a process contaminant formed during high-temperature processing of carbohydrate-rich foods and is classified by the European Food Safety Authority (EFSA) as a genotoxic and carcinogenic compound. The assessment was conducted using a conservative deterministic approach based on national consumption data for children and adults, body weight assumptions, and occurrence data for acrylamide in potato chips from the Montenegrin market. Acrylamide concentrations were determined in an accredited laboratory at the Centre for Ecotoxicological Research using liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS), in accordance with MEST EN 16618:2016. The analytical method was validated and routinely applied, with performance verified through proficiency testing schemes and collaboration with the European Union Reference Laboratory for Processing Contaminants (EURL-PC). Estimated daily intakes (EDI) were calculated for mean and high consumers (P95), and risk characterisation was performed using EFSA's benchmark dose lower confidence limit (BMDL10) of 0.17 mg/kg bw/day for tumour formation. MOE values ranged from approximately 144 to 621 across population groups, all substantially below the reference value of 10,000, indicating a potential public health concern, particularly for children.

Key sources of uncertainty include variability in acrylamide concentrations, assumptions related to consumption patterns, and the use of mean occurrence values. The findings highlight the need for targeted monitoring, mitigation measures in food production, and improved risk communication, particularly for vulnerable population groups. These results underline the importance of continuous monitoring and implementation of mitigation strategies to reduce population exposure to acrylamide.

Keywords: acrylamide, LC-MS/MS, risk assessment, dietary exposure, MOE, Montenegro

The role of Transfer stations in an efficient Waste management system

D. Vuksanović [1], D. Radonjić [1], J. Šćepanović [1]

[1] Faculty of Metallurgy and Technology, Podgorica, Montenegro, e-mail: darkov@ucg.ac.me

Abstract:

The current problem of waste management is to relieve the environment as much as possible of the huge amounts of communal waste, which is being created more and more. The existing low level of primary selection and further processing of waste congests the existing sanitary landfills, as a result of which their service life is significantly shortened. In order to build a transfer station as an important link between the place of waste generation and the place of its further treatment, it is necessary to evaluate the justification of its construction based on a comprehensive technical, spatial, economic, social and ecological analysis.

Waste occurs in all stages of the aforementioned logistics concept of business, i.e. from the procurement of primary raw materials, production itself, distribution and sale of finished products, packaging and unpacking, transshipment, transportation, storage, etc. A product that ends its useful life becomes waste. In addition to industry, waste is generated by public institutions and households in everyday life. Therefore, waste is defined as materials that arise in the process of living, performing production or some other activity, and which are excluded from use. Waste is divided into: municipal (household), commercial, industrial and medical. Depending on its hazardous characteristics, inert, non-hazardous and hazardous waste are distinguished. Also, there is inorganic and organic waste etc.

The aim of the work is to demonstrate their necessity and place in an efficient waste management system through the operational role of transfer stations and their construction in certain local self-governments in Montenegro.

Key words: Transfer station, waste management, sanitary landfills

Author Index

Author Index

(Numbers indicate the page on which the abstract begins.)