

ESOS 2023



5TH YOUNG SCIENTISTS' DAY

Department of Physics
Josip Juraj Strossmayer University of Osijek

BOOK OF ABSTRACTS

ORGANISERS:





5TH YOUNG SCIENTISTS' DAY

5th Young Scientists' Day Conference
November 14th 2023, Osijek, Croatia

BOOK OF ABSTRACTS

Znanstveni skup mladih istraživača
14. studenoga 2023. godine, Osijek, Hrvatska

KNJIGA SAŽETAKA

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2023



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CONFERENCE PROGRAMME

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Medicinski fakultet Osijek
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ORGANISERS



Dan mladih istraživača

CONFERENCE PROGRAMME
November 14th 2023

PROGRAM KONFERENCIJE
14. studeni 2023. godine

08:30 – 09:00 Registracija sudionika

Registration of participants

09:00 – 09:30 Otvaranje konferencije

Conference opening

Pozdravna riječ Opening speech

Prof. dr. sc. Vlado Guberac, rektor Sveučilišta Josipa Jurja Strossmayera u Osijeku
Prof. dr. sc. Sonja Vila, prorektorica za znanost, tehnologije, projekte i međunarodnu suradnju Sveučilišta Josipa Jurja Strossmayera u Osijeku
Izv. prof. dr. sc. Vanja Radolić, Pročelnik Odjela za fiziku Sveučilišta Josipa Jurja Strossmayera u Osijeku
Izv. prof. dr. sc. Igor Lukačević, zamjenik pročelnika za znanstveno istraživačku djelatnost Odjela za fiziku Sveučilišta Josipa Jurja Strossmayera u Osijeku

09:30 – 10:20 Prva sekcija predavanja

First section of lectures

Moderatori: prof. dr. sc. Zvonko Antunović, prof. dr. sc. Ivana Majić, prof. dr. sc. Stela Jokić, prof. dr. sc. Đurđica Ačkar

09:30 – 09:40 Mirna Brekalo

Transformacija taloga kave u celulozne nosače za imobilizaciju enzima
Transformation of Spent Coffee Grounds to the Cellulose-Based Enzyme
Faculty of Food Technology Osijek

09:42 – 09:52 Gabriela Perković

Kako kreirati bioaktivne mikrokapsule koje daju vrijednost nusproizvodima iz proizvodnje vina i kozjeg sira
How to make bioactive microcapsules that add value to by-products in the production of wine and goat cheese
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CONFERENCE PROGRAMME
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14. studeni 2023. godine

09:54 – 10:04

Luka Drenjančević

Fenotipska stabilnost gen kolekcije pšenice
Phenotypic stability of wheat gene collection

Faculty of Agrobiotechnical Sciences Osijek / Croatian Agency for Agriculture and Food

10:06 – 10:16

Sanja Grubišić Šestan

Bioraspoloživost K, Ca, Mg, Mn, Fe, Zn i Se iz pšenične trave (*Triticum aestivum* L.)
Bioavailability of K, Ca, Mg, Mn, Fe, Zn and Se from wheatgrass (*Triticum aestivum* L.)

Faculty of Agrobiotechnical Sciences Osijek

10:20 – 10:30 Pauza
Break

10:30 – 11:20 Druga sekcija predavanja

Second section of lectures

Moderatori:

**prof. dr. sc. Ines Drenjančević, izv. prof. dr. sc. Ana Stupin, prof. dr. sc. Martina Smolić,
izv. prof. dr. sc. Kristina Bojanić**

10:30 – 10:40

Dražen Mlinarević

Utjecaj spola i starenja na metabolizam glukoze i IgG glikom štakora u modelu kroničnog stresa

The effect of gender and aging on rat glucose metabolism and IgG glycome in a model of chronic stress

Faculty of Medicine Osijek

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Liraglutide Exerts Protective Effects in Huh7 Cell Culture Models of Non-Alcoholic Steatosis and Drug-Induced Steatosis

Faculty of Dental Medicine and Health Osijek

11:20 – 11:30 Pauza
Break

11:30 – 12:20 Treća sekcija predavanja

Third section of lectures

Moderatori:

doc. dr. sc. Anita Galir Balkić, izv. prof. dr. sc. Dubravka Špoljarić Maronić, doc. dr. sc. Olivera Galović, izv. prof. dr. sc. Martina Medvidović-Kosanović

11:30 – 11:40

Nikolina Bek

Što se nalazi u sedimentu Sakadaškog jezera (Park prirode Kopački rit)?

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Protumorska učinkovitost novog bakrovog(II) kompleksa na humanim 2D i 3D staničnim modelima *in vitro*

Antitumor efficacy of a new copper(II) complex on human 2D and 3D cell models *in vitro*
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Dominik Goman

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Influence of gallic acid on the spontaneous precipitation of calcium carbonate
Josip Juraj Strossmayer University of Osijek, Department of Chemistry

12:20 – 12:30 Pauza
Break

12:30 – 13:20 Četvrta sekcija predavanja

Fourth section of lectures

Moderatori:

izv. prof. dr. sc. Igor Lukačević, doc. dr. sc. Maja Varga Pajtler, izv. prof. dr. sc. Zoran Tomljanović, prof. dr. sc. Kristian Sabo

12:30 – 12:40

Danijela Dodlek

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Dan mladih istraživača

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12:54 – 13:04

Bartol Borozan

Odabir marker gena
Marker gene selection

School of Applied Mathematics and Computer Science

13:06 – 13:16

Antonio Jovanović

Problem umjetničke galerije
Art Gallery problem

School of Applied Mathematics and Computer Science

13:20 – 13:30

Zatvaranje konferencije

Closing the conference

13:30 –

Ručak za aktivne sudionike

Conference lunch

ESOS 2023



**5TH
YOUNG
SCIENTISTS'
DAY**

Sažetci izlaganja

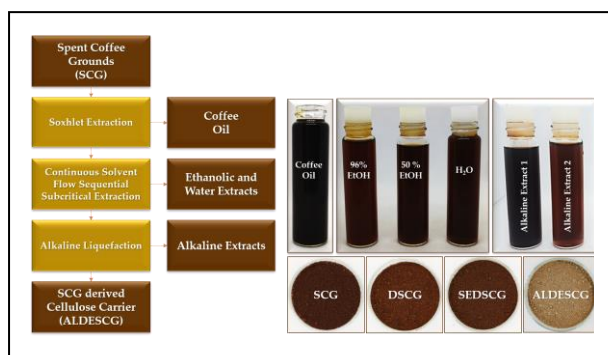
Presentation abstracts

Transformacija taloga kave u celulozne nosače za imobilizaciju enzima Transformation of Spent Coffee Grounds to the Cellulose-Based Enzyme Immobilization Carrier

M.Brekalo^{1,*}, K.Aladić¹, S.Budžaki¹, S.Jokić¹, L.Jakobek Barron¹, I.Strelec¹

¹ Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31 000 Osijek, Croatia

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The aim of this study was to examine the possibility of transformation of spent coffee grounds (SCG) to the cellulose-based enzyme immobilization carrier, by multi-step extraction. Soxhlet extraction with *n*-hexane was the first step in SCGs transformation, where SCG oil was obtained, while the remaining solid residue subjected to continuous solvent flow sequential subcritical extraction using 96% and 50% ethanol and water. The last transformation step

included alkaline liquefaction of solid residue with 8% NaOH in order to cellulose-enriched SCG as a potential enzyme immobilization carrier. Transformation process was monitored by chemical composition analysis of both, obtained extracts and solid residues. Soxhlet extraction of 100 g of SCG yielded 10.58 g of SCG oil rich in linoleic and palmitic acid, while continuous solvent flow sequential subcritical extraction a total of 1.63 g of protein, 5.58 g of sugar, 204 mg of caffeine, and 76 mg chlorogenic acid. Alkaline liquefaction of 100 g of sequentially extracted defatted SCG with 8% NaOH yielded 20.83 g of cellulose-enriched SCG and 7.45 g of protein, 8.63 g of total polyphenols and 50.73 g of sugars present in extracts. Cellulose-enriched SCGs fulfilled the criteria to be used as potential enzyme immobilization carrier, what was additionally proven by its suitability for *Burkholderia cepacia* lipase immobilization by adsorption.

Keywords: spent coffee grounds; Soxhlet extraction; continuous solvent flow sequential subcritical lexttraction; alkaline liquefaction; cellulose-based enzyme immobilization carrier, lipase immobilization

Kako kreirati bioaktivne mikrokapsule koje daju vrijednost nusproizvodima iz proizvodnje vina i kozjeg sira

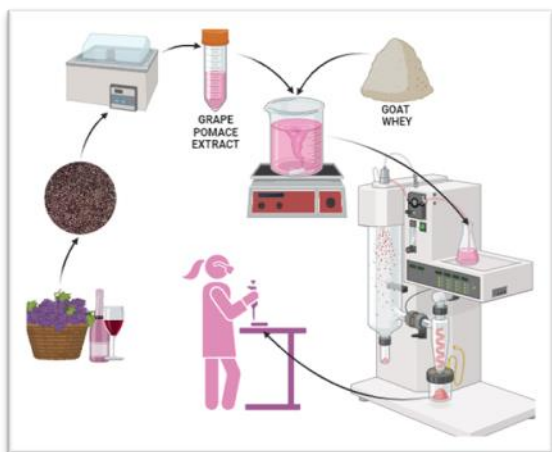
How to make bioactive microcapsules that add value to by-products in the production of wine and goat cheese

Gabriela Perković*, Ana Bucić-Kojić, Mirela Planinić

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, HR-31000 Osijek, Croatia

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With population growth, globalisation and various food trends, the amount of processed food increased and with it the amount of waste generated by improperly disposed by-products of the various food industries. In recent decades, awareness of the importance of upcycling has grown with increased environmental demands, and there is a growing body of research aimed at exploring the possibilities of using food industry by-products to develop new products for human consumption. Two such examples are grape pomace (GP) and goat whey (GW), by-products of winemaking and the dairy industry respectively. GP is rich in a variety of phenolic substances that may

have antioxidant, antiproliferative, antiviral and antimicrobial effects, while GW is rich in proteins, minerals and vitamins and also contains inulin. In this study, the phenolic compounds were extracted from GP and the liquid GP extract was microencapsulated by spray drying, using powdered GW (2.5%, w/v) as the main coating material. The effects of GW alone or in combination with co-coating on encapsulation yield, encapsulation efficiency, microcapsule (powder) properties and retention of phenolic compounds during a simulated *in vitro* digestion process were investigated. The co-coatings (maltodextrin (DE 4-7), trehalose, sucrose, xylose) were added such that a certain percentage of GW (from 2.5 % to 30 %) was replaced by the co-coating to stabilise the whey protein. High encapsulation yields of 91.18 - 99.77 % and encapsulation efficiencies of 77.59 % to 95.47 % were achieved, depending on the coating(s) used. Likewise, the concentration of total phenolic compounds released during simulated *in vitro* digestion of microbeads (without enzymes) in the small intestine varied from 84.54 to 111.92 mgGAE/gDM. During simulated *in vitro* digestion with enzymes, there is a significant increase in the concentration of individual phenolic compounds in the small intestine phase, demonstrating the success of the role of GW alone, but also in combination with other co-coatings, as a protective material for phenolic compounds from GP extract.

This work was supported by the Croatian Science Foundation under the project (IP-2018-01-1227) „Development of a sustainable integrated process for the production of bioactive isolates from food industry residues” (POPI-WinCEco) and BILATERAL PROJECT CROATIA–HUNGARY, grant number: HRHUN_2020_011.

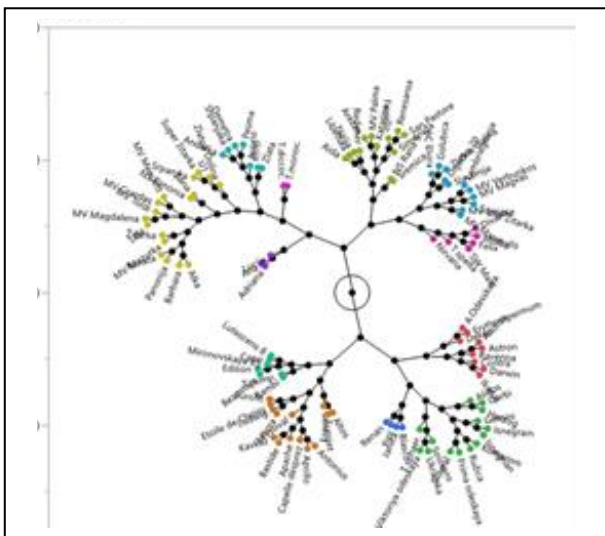
Keywords: grape pomace, phenolic compounds, goat whey, microencapsulation, spray drying

**Bioraspoloživost K, Ca, Mg, Mn, Fe, Zn i Se iz
pšenične trave (*Triticum aestivum* L.)
Bioavailability of K, Ca, Mg, Mn, Fe, Zn and Se from
wheatgrass (*Triticum aestivum* L.)**

S. Grubišić Šestanj^{1,*}

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Wheatgrass represents young shoots of wheat (*Triticum aestivum* L.) that, due to their high nutritional value, are used as a natural food supplement in the form of fresh juice, powder, or tablets. Bioavailability is defined as the amount of nutrients available for absorption into the body and can be tested *in vivo* and *in vitro* with digestion simulation models. The aim of this research is to examine the variability of wheat genotypes based on total and *in vitro* bioavailable concentrations of K, Ca, Mg, Mn, Fe, Zn, and Se in wheatgrass juice. In addition, the influence of biofortification of Zn and Se and the influence of different harvest dates on the total and *in vitro* bioavailable concentrations of K, Ca, Mg, Mn, Fe, Zn, and Se in

juice and powder of wheatgrass of selected genotypes were examined. One of the main goals of this research was to identify wheat genotypes for the cultivation of wheatgrass, which, given their mineral composition, can be recommended for direct use as a dietary supplement. Simulation of *in vitro* digestion was carried out using the standardized method according to Minekus et al. (2014), while total concentrations were determined by the ICP-OES technique. The conducted research revealed a large variability between the tested genotypes with regard to the total and *in vitro* bioavailable concentrations of the tested elements. A statistically significant influence ($p < 0.001$) on the total concentrations of Ca, Mg, K, Mn, Fe, Zn, and Se and *in vitro* bioavailable concentrations of Ca, Mg, Mn, Fe, and Zn in wheatgrass juice was also determined at different harvest dates. The conducted research determined a higher *in vitro* bioavailability of all tested elements in the juice compared to the wheatgrass powder, but it should be noted that the concentration of the elements in the powder is higher than in the wheatgrass juice.

Keywords: wheatgrass, bioavailability, simulation digestion *in vitro*, biofortification, mineral composition

Utjecaj spola i starenja na metabolizam glukoze i IgG glikom štakora u modelu kroničnog stresa
The effect of gender and aging on rat glucose metabolism and IgG glycome in a model of chronic stress

D.Mlinarević*¹, R.Blažeković¹, M.Heffer¹

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The objective of this study was to investigate age- and sex-related changes in the levels of androstendione, glucose metabolism and IgG glycome in a model of chronic stress. We conducted a controlled animal experiment using tissue samples from a biobank established in a previous study. The experiment included a total of 80 Sprague-Dawley rats of both genders and from two different age groups – young rats (3.5 months old) and old rats (12 months old). Four groups of rats (young and old males, young and old females) were subjected to a protocol of chronic stress and four age- and sex-matched groups served as „sham“ control groups. We measured the levels of androstendione before and after the stress protocol. After sacrificing, we performed immunohistochemistry analysis of membrane glucocorticoid receptor (mGR) and 11-beta-hydroxylase (CYP11B1) expression. We also analyzed the glycome of immunoglobulin G, which was measured in three time-points – before, during and after the stress protocol. Additionally, we performed glucose tolerance tests and insulin tolerance tests in rats subjected to chronic stress. The results of GTT and ITT will be analyzed using a non-linear mathematical model. We did not find statistically significant differences in androstendione levels, but there was a significant interaction with age ($p < 0.001$) due to a dysregulated stress response in older rats. We observed gender and age changes in variables quantifying glucose metabolism derived from the mathematical model for GTT and ITT. The observed changes in mGR and CYP11B1 expression point to a gender-dimorphic response to chronic stress. We found significant changes in galactosylation of IgG2a and IgG2c subclasses in young females and IgG2b in old females, with no significant changes in male rats. These results suggest a significant effect of aging and gender on the stress response. In conclusion, chronic stress induces age-related and gender-related changes in glucose metabolism and immunoglobulin G glycome.

Keywords: *immunoglobulin G, glycome, glycosylation, chronic stress*

Uloga dušikovog oksida u mikro- i makrovaskularnom odgovoru na 7-dnevno opterećenje kuhinjskom soli u zdravih pojedinaca

The role of nitric oxide in the micro- and macrovascular response to 7-day high salt intake in healthy individuals

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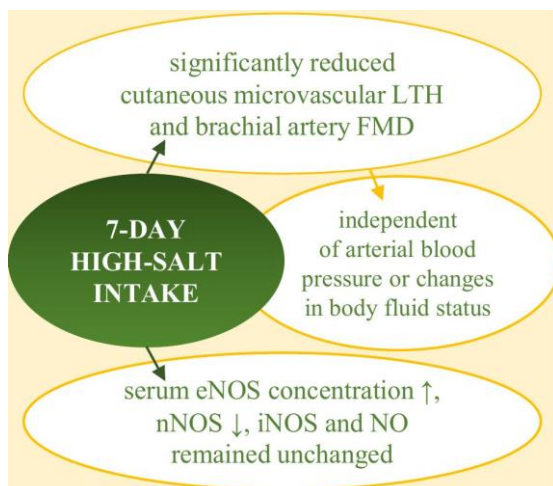
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Objectives: to investigate the effect of a 7-day high-salt (HS) diet on the specific role of nitric oxide (NO) in the micro- and macrovascular response to a 7-day high salt intake in healthy individuals. Additional goal is to examine the concept of non-osmotic sodium storage in the skin.

Study design: non-randomized controlled trial.

Participants and methods: 46 young healthy people of both sexes. The first 7 days they were on a low-salt diet (LS) (3.5 g salt/day), then on a high-salt diet (HS) (~14.7 g salt/day). Endothelial nitric oxide-mediated vasodilatation in the microcirculation was assessed by measuring local thermal skin hyperemia (LTH) using laser Doppler flowmetry (LDF), and in the

macrocirculation by measuring the flow-mediated dilation (FMD) of the brachial artery using ultrasound before and after HS diet. Body fluid status was assessed using a 4-terminal noninvasive analyzer, systemic hemodynamics and arterial blood pressure were measured using impedance cardiography (ICG). Concentrations of NO, three NOS enzyme isoforms (eNOS, iNOS and nNOS) and VEGF-C were measured before and after the HS diet.

Results: results of 24-hour urinary sodium excretion confirmed that all participants adhered to protocol. 7-day HS diet significantly reduced LTH and brachial artery FMD, independent of arterial blood pressure or changes in body fluid status. Serum eNOS concentration increased, nNOS decreased, iNOS and NO remained unchanged. Serum VEGF-C, interstitial fluid volume, SVRI remained unchanged.

Conclusion: 7-day HS diet causes impairment of nitric oxide-dependent endothelial vasodilation in the microcirculation and macrocirculation, independent of changes in arterial pressure. Dissociation in response of eNOS and nNOS indicates a complex adaptation of the main isoforms of NO-generating enzymes. Results on serum VEGF-C level, interstitial fluid volume, and SVRI failed to support the concept of non-osmotic sodium storage in the skin, at least in terms of such short-term dietary salt modulation in healthy subjects.

Keywords: arterial hypertension; macrocirculation; microcirculation; nitric oxide synthase; vascular endothelial growth factor

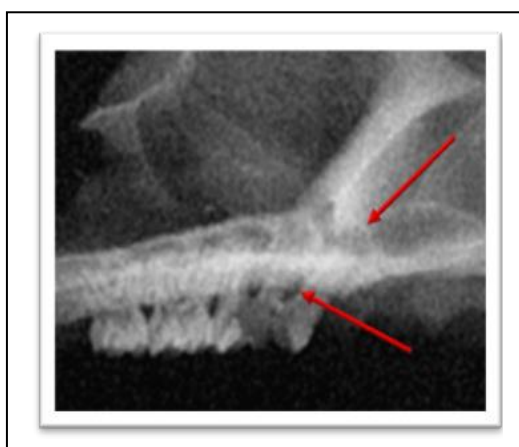
Sistemska primjena pentadekapeptida BPC 157 u terapiji inducirane periapikalne lezije
Systemic administration of pentadecapeptide BPC 157 in the treatment of induced periapical lesion

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Apical periodontitis is one of the most common inflammatory conditions of the teeth. Despite the frequent failure of mechanical cleaning as the gold standard, especially in teeth with pulp necrosis, there is still no alternative therapy that would reduce bone resorption in the periapical part and preserve the tooth. The pentadecapeptide BPC 157 (*Body Protective Compound*) is a stable gastric peptide and it has shown great healing potential in various animal studies in many experimental models to date. It is soluble in water and saline, it is safe for use because the lethal dose (LD1) was never achieved and there were no side effects in trials. This study aimed to analyze the effect of

pentadecapeptide BPC 157 on induced periapical lesions.

A trepanation procedure was performed on the first right maxillary molar of rats. Treatment groups received oral BPC 157 at doses of 10ng/kg or 10µg/kg, while the control group consumed water. Saliva and oral swabs were collected for microbiological examination. The affected tooth and adjacent tissue underwent histological and molecular analysis, and the experiment was observed through macroscopic and radiological methods. The untreated group showed higher susceptibility to cracking around the trepanation site. Microbiological analysis revealed consistent findings in all rats. Rats treated with BPC 157 exhibited reduced radiographic apical bone loss and furcation defects, confirmed by histological analysis. RT-qPCR analysis showed significant effects on gene expression (*Egr1*, *Ptgs2*, *Nos2*, *Nos3*) in BPC 157 treated groups compared to the control.

The positive impact of BPC 157 suggests promising avenues for additional research and presents a new perspective on periapical lesion treatment.

Keywords: apical periodontitis, BPC 157, healing

Liraglutid ostvaruje protektivan učinak u Huh7 staničnom modelu nealkoholne steatoze i lijekovima uzrokovane steatoze

Liraglutide Exerts Protective Effects in Huh7 Cell Culture Models of Non-Alcoholic Steatosis and Drug-Induced Steatosis

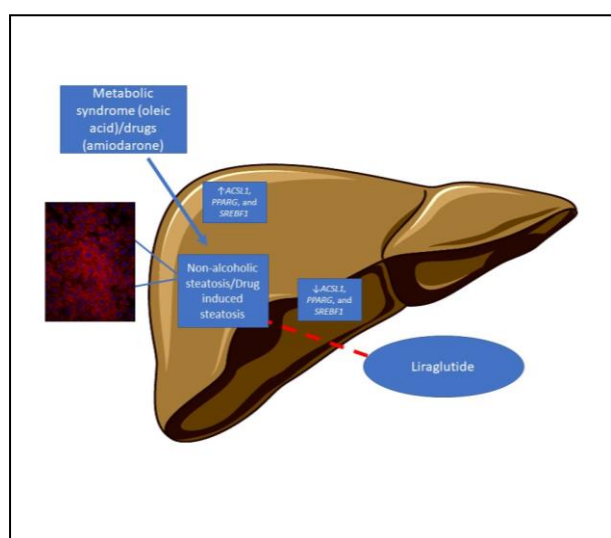
T. Omanović Kolarić^{1,2*}, T. Kizivat^{2,3}, V. Mihaljević^{1,2}, L. Kuna Roguljić¹, A. Petrović^{1,2}, I. Bilić-Ćurčić^{2,3}, R. Smolić^{1,2}, A. Včev^{1,2}, H. Roguljić^{2,3}, N. Raguž-Lučić¹, M. Smolić^{1,2}

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Numerous worldwide health issues, including polypharmacy with an increased risk of drug-induced liver injury and nonalcoholic fatty liver disease (NAFLD), emerge as the population ages and the prevalence of obesity rises. A drug like amiodarone has the potential to cause or worsen pre-existing NAFLD. As a result, it is becoming more and more important to treat NAFLD and drug-induced steatosis (DIS) appropriately. Liraglutide is a glucagon-like peptide-1 (GLP-1) receptor agonist that has hepatoprotective benefits. The aim of our study was to establish cell culture models of non-alcoholic steatosis (NAS) and DIS, and to assess the effect of liraglutide in these models. To

create cell culture models of NAS and DIS, Huh7 cells were treated with 0.5 mmol L⁻¹ oleic acid and 20 μmol L⁻¹ amiodarone for 24 hours. These cell culture models were cotreated with 5 nmol L⁻¹ and 20 nmol L⁻¹ liraglutide. The MTT assay was used to assess cell survival, and a fluorescence microscope was used to visualize lipid accumulation and nuclei in these models using Oil-Red-O (ORO) and DAPI staining. The TGO-PAP technique was used to quantify the accumulation of triglycerides within the cells. The expression of genes implicated in lipogenesis and enhanced ROS accumulation (*ACSL1*, *PPARG*, and *SREBF1*) was measured by RT-PCR. Liraglutide improved cell survival in both models ($p < 0,05$). A statistically significant increase in lipid accumulation was observed in NAS and DIS models ($p < 0,05$, $p < 0,01$), with higher triglyceride concentration ($p < 0,001$), while co-treatment with liraglutide reduced them in NAS and DIS models ($p < 0,01$, $p < 0,05$). Liraglutide reduced the expression of the lipogenic *ACSL1*, *PPARG*, and *SREBF1* ($p < 0,01$) pathways in the hepatocyte steatosis NAS and DIS models. Liraglutide decreased hepatocyte steatosis in NAS and DIS models of hepatocyte steatosis established in Huh7 cell culture by downregulating the lipogenic *ACSL1*, *PPARG*, and *SREBF1* pathways.

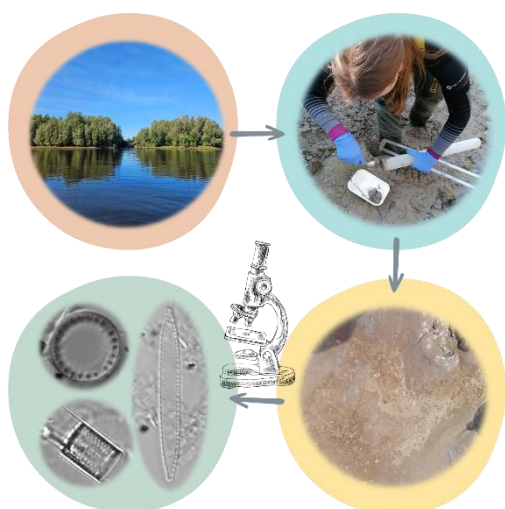
Keywords: Liraglutide; Non-Alcoholic Fatty Liver Disease; Drug-induced Liver Injury; Amiodarone; Cell-culture

Što se nalazi u sedimentu Sakadaškog jezera (Park prirode Kopački rit)? What is found in the sediment of Lake Sakadaš (Kopački Rit Nature Park)?

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Sediment is an untethered material deposited at the bottom of an aquatic ecosystem. Within various sediment types, both solid particles and microphytes (algae and cyanobacteria) play a vital role in preserving the structure and functionality of aquatic ecosystems. Diatoms (Bacillariophyceae) are notably the most abundant microphyte group in sediment samples. To determine the monthly changes in water physico-chemical factors and sediment diatom assemblage in the floodplain Lake Sakadaš the study was undertaken in different seasonal and hydrological conditions in 2021 (February-September). Based on the environmental parameters, the data separated into three groups regarding the seasonal and hydrological conditions. Also, the highest diversity of diatom taxa was recorded in the

same period (February: 93, May: 72, June: 77 taxa). The total nitrogen content was the highest at the beginning of the year (February: 4.00 mg L⁻¹) during higher water levels, followed by increased nitrate concentrations, while total phosphorus concentration was the highest in March (0.27 mg L⁻¹). The content of dissolved oxygen was higher in the first months of the research (11.08 – 13.83 mg L⁻¹) and lower later in the year (5.62 – 7.6 mg L⁻¹), as well as the pH value. During the investigation, a total of 144 diatom taxa were recorded. Among 24 dominants, *Stephanodiscus hantzschii* Grunow, *Nitzschia palea* (Kützing) W.Smith and *Aulacoseira granulata* var. *angustissima* (O.Müller) Simonsen were the most represented. Considering the recorded great diversity and abundance of diatoms, which are good water quality indicators, continuous research in such rare and endangered river-floodplain systems is necessary.

Keywords: microphytes, diatoms, floodplain

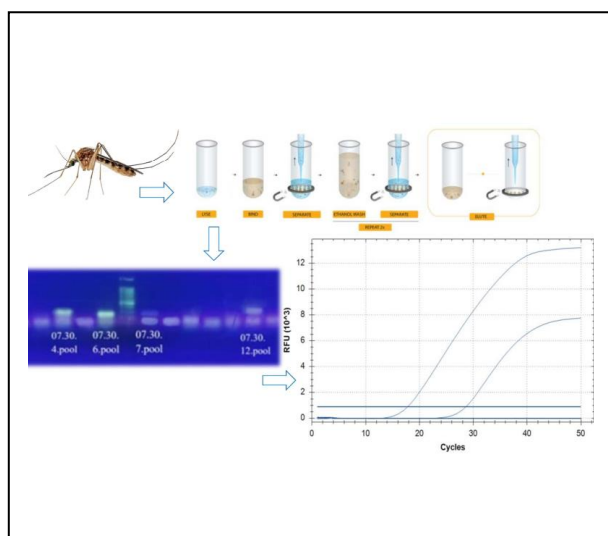
Detekcija flavivirusa i Chikungunya virusa u komarcima Detection of flavivirus and Chikungunya virus in mosquitoes

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Infections with arboviruses are becoming more common throughout Europe, and Croatia is no exception. Arboviruses from the Flaviridae family (*Flavivirus*), which includes the medically important yellow fever virus (YFV), dengue fever virus (DENV), Japanese encephalitis virus (JEV), and West Nile virus (WNV), as well as viruses from the Togaviridae family (*Alphavirus*), which includes Chikungunya virus, are transmitted by mosquitoes. Two autochthonous dengue virus (DENV) infections were reported in the Croatian littoral area in 2010. The first cases of neuroinvasive West Nile virus disease in humans were detected in 2012. The aim of this study was to detect flaviviruses and Chikungunya virus in mosquitoes in the

Vukovar-Srijem County region. Sampling was conducted from June to August 2023 and mosquitoes were sampled using CDC and BG-Sentinel traps. Individuals of *Culex* spp. and *Aedes albopictus* were separated. A total of 195 pooled mosquito samples were obtained. Samples were pooled based on species, locations, and dates of sampling, which included a maximum number of 25 individuals per sample. Flaviviruses were detected using conventional heminested PCR. Eight collective mosquito samples were positive for flaviviruses, and WNV RNA was detected in only one sample (6th pool: ILOK 2/9, ILOK 2/10, ILOK 2/11). Phylogenetic analysis revealed that this sample was 98% identical to a WNV isolate (genotype 2) derived from a human sample collected in Hungary in 2021 (GenBank Acc.No.: OP179287.1). A pooled sample of *Culex* spp. was further analyzed by real-time RT-qPCR where the ILOK2/9 tube was positive for WNV RNA and the other two were negative. Real-time RT-qPCR analysis for the Chikungunya virus was negative for all samples. Given that arboviruses have (re)emerged in Croatia several times in the last two decades and that the country is surrounded by countries that frequently report similar problems, it is essential that vector-related risk factors are continuously monitored and assessed.

Keywords: West Nile virus, *Culex* spp, RT-qPCR, molecular analysis

Protutumorska učinkovitost novog bakrovog(II) kompleksa na humanim 2D i 3D staničnim modelima *in vitro*
Antitumor efficacy of a new copper(II) complex on human 2D and 3D cell models *in vitro*

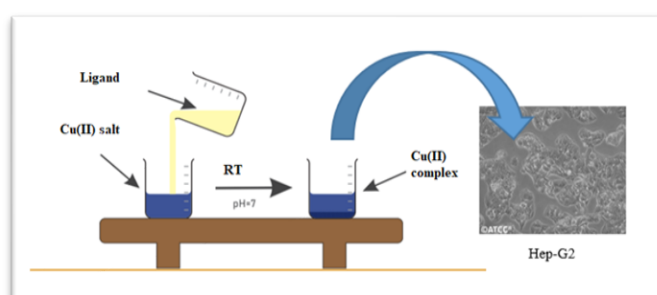
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The first considerations of the antitumor activity of copper complexes were made in the 1960s. [1] Our research focuses on the new Cu(II) complex with chromone-2-carboxylic acid. The copper complex was synthesized from $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$ and chromone-2-carboxylic acid as ligand. The investigated complex suppressed cell growth of Hep-G2 cells by 64.8% at the

highest concentration (10^{-5} M), followed by NCI-H358, MRC5 and HT-29 (45.6% ; 45.3% ; 43.4%). The inhibitory effect of the complex on the cell lines KATO III, MDA-MB 231 and Caco-2 is less than 25%, indicating low antiproliferative activity. The activity of the pure ligand was also tested by MTT assay, and the percentage of survival of all cell lines was more than 95%. The biological activity of the complex was also tested in 3D cell cultures (Caco-2 ; HT-29 ; MRC-5). During a single treatment, the tested complex inhibits the growth of the HT-29 cell line by about 50 % at a concentration of 10^{-6} M while it shows extremely high activity on that cell line at a concentration of 10^{-5} M (cca. 80 %). The tested complex did not show a significant cytotoxic effect on the MRC-5 cell line in any type of treatment, at any concentration. The results clearly indicate that the novel copper(II) complex may represent a promising structural starting point for the development of a new generation of potential antitumor agents.

Keywords: copper(II) complex, MTT assay, 2D and 3D cell models, antiproliferative activity

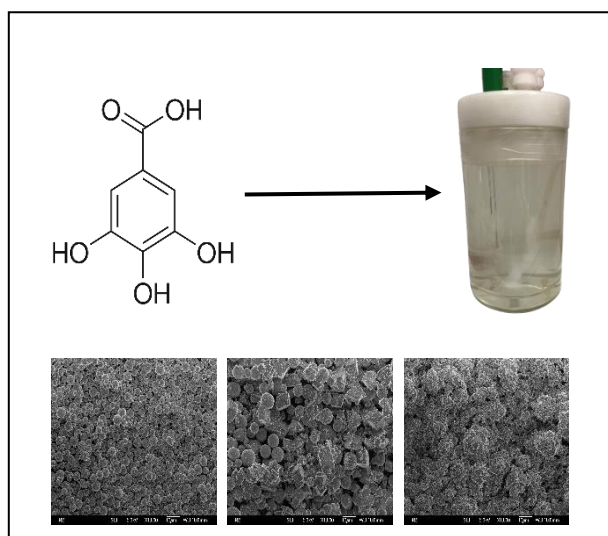
Utjecaj galne kiseline na spontano taloženje kalcijeva karbonata Influence of gallic acid on the spontaneous precipitation of calcium carbonate

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Organisms such as seagrasses and algae produce secondary metabolites such as phenolic compounds to compensate for the impact of climate change. However, the question arises whether phenolic compounds will react to CaCO₃, which is the primary building block of hard tissues of molluscs and corals, also present in this environment?

In this research, two goals were set: to determine the stability constant of the complex of gallic acid (H₄GA) and calcium, and to investigate the influence of H₄GA on the spontaneous precipitation of CaCO₃, the mineralogical composition and the morphology of the precipitated solid. In order to determine the stability constant, the differential pulse

voltammetry, potentiometry and UV-VIS spectroscopy were used. It was determined with potentiometric titration that the stability constant of the calcium gallate complex is $K^\circ = 4.83 \cdot 10^6$ ($\log K^\circ = 6.7$), while using the last two techniques, the metal:ligand ratio in the complex was determined to be 2:1. The obtained results were used in a mathematical program for calculation of ionic composition of the solution as well as other parameters in the CaCO₃ precipitation system. Precipitation experiments were carried out at 25 °C in the system with initial reactants concentrations $c(\text{Ca}^{2+}) = c(\text{CO}_3^{2-}) = 2.5 \text{ mmol dm}^{-3}$ without addition (model system) and with the addition of H₄GA ($5 \cdot 10^{-6} \text{ mol dm}^{-3} \leq c(\text{H}_4\text{GA}) \leq 1 \cdot 10^{-4} \text{ mol dm}^{-3}$). The precipitation process was monitored potentiometrically, and the obtained precipitates were analyzed by FT-IR spectroscopy, X-ray diffraction and scanning electron microscopy. It was observed that an increase in the initial concentration of H₄GA added to the CaCO₃ precipitation system caused: a) increased inhibition of the nucleation and growth of CaCO₃ crystals, b) change in the phase composition of the precipitate and c) change in the morphology of the precipitated CaCO₃.

Keywords: calcium carbonate, gallic acid, stability constant, spontaneous precipitation, climate change

Kako nastavnici odgovaraju na uenika objašnjenja How teachers respond to students' explanations

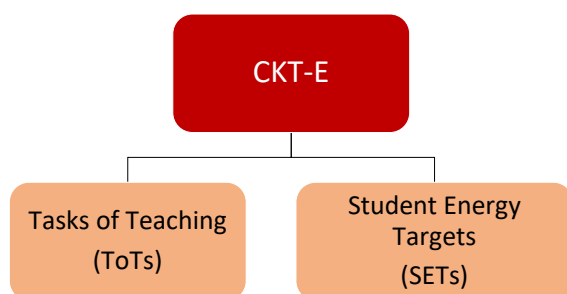
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To help students learn teachers need to be attentive and responsive to students' explanations. While recognising and addressing problematic aspects of students' explanations is important, teachers also need to be able to recognise the seeds of productive ideas even when they are hidden in incorrect explanations. By recognising the strengths in students' explanations, teachers can build on them to help their students move forward. These skills are a part of the teachers' Content Knowledge for Teaching (CKT) framework created by Ball and colleagues for teaching mathematics. Etkina and colleagues extended the model of CKT to the field of physics, specifically energy –

CKT-E. CKT-E includes two components: Tasks of Teaching (ToTs) and Student Energy Targets (SETs). ToTs represent activities which teachers do during instruction and SETs represent important disciplinary ideas, science practices and cross-cutting concepts important for student learning of energy. By using the ToTs framework for analysing teachers' responses to students' explanations, our aim was to answer the following research questions:

- (1) How do teachers interpret and respond to students' incorrect explanations?
- (2) How do teachers interpret and respond to students' correct explanations?
- (3) What are the differences in responses to students' explanations among different groups of in-service and pre-service teachers?

The survey contained the text of the problem and four students' written explanations of their answer choice. The participants were asked to write student's strengths and weaknesses and to provide their hypothetical response to the student. We used several ToTs to develop descriptive coding schemes to analyse participants' responses.

Keywords: Content Knowledge for Teaching, teacher knowledge, formative assessment, tasks of teaching, feedback

Razdoblje pojačane aktivnosti izvora BL Lacertae 2020 – viševalni pristup BL Lacertae flaring period in 2020 – a multiwavelength perspective

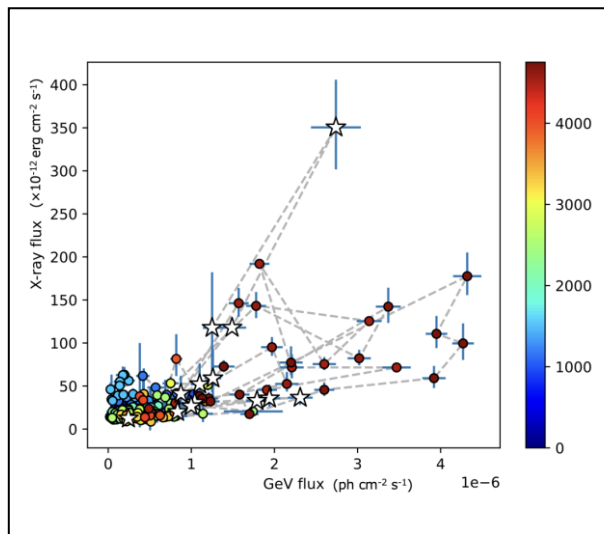
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The Abstract In 2020, MAGIC telescopes recorded an increase in the very-high-energy (VHE; >100 GeV) gamma-ray flux from BL Lacertae (BL Lac). It is a low-frequency peaked blazar with a spectral peak within the GeV domain. The MAGIC observations were triggered by the detection of the all-time highest flux at optical wavelengths, a high state in gamma rays and X-rays. Between August and October 2020, MAGIC carried out a series of monitoring observations utilising GeV, X-ray, optical, and radio measurements. During this timeframe, MAGIC identified BL Lac in the TeV gamma-ray band on multiple occasions, including an extraordinary flare on the night of the 19th of September, where it showed VHE gamma-ray flux as high as 5 C.U. (above 100

GeV). In addition, MAGIC also detected minutes-scale intra-night variability. Together with the datasets obtained by other telescopes, we constructed the multiwavelength spectrum during the flare to model the emission mechanism. The X-ray and GeV gamma-ray fluxes correlate in the long-term light curve. However, there has been a change in the X-ray-to-GeV-gamma-ray flux ratio. These correlations across multiple wavelengths could shed light on the emission mechanisms and source of the TeV flare that has been observed.

This contribution will delve into the TeV emission source of BL Lac during the flaring period in 2020 and its minutes-scale flux variability, as well as its relationship to the results observed across multiple wavelengths.

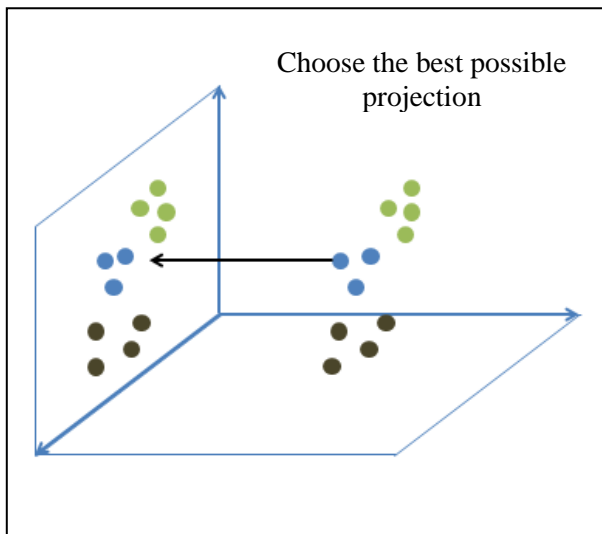
Keywords: MAGIC telescopes, BL Lacertae, Multiwavelength observations

Odabir marker gena Marker gene selection

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Single cell RNA-sequencing provides partial transcripts in hundreds of thousands of cells. An important goal of single cell RNA-seq analysis is to assign a label (cell type) to each cell based on the expressions of its genes. Due to the large number of genes, labelling each cell is a computationally difficult task. Choosing a small subset of genes that accurately represent the data would significantly improve the performance of cell labelling. Additionally, experimental methods used to measure gene expression can only process a handful of genes, also known as markers, at a time. Our aim is to develop a method that, when given single cell RNA-seq data, effectively identifies and selects marker genes.

Keywords: scRNA-seq, gene expression

Problem umjetničke galerije Art Gallery problem

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The Art Gallery problem is a visibility problem in computational geometry where the task is to minimize the number of guards in a simple polygon. In other words, the goal is to identify a minimal set of points within the polygon, known as guards, so that every point inside the polygon is visible to at least one guard. This visibility is determined by a line segment connecting each point to a guard, entirely contained within the polygon. Between the different variants of the problem, we focus on the case where guards are chosen from the set of polygon vertices. There are several elegant proofs that the optimal number of guards in an n -sided polygon is at most $\lfloor \frac{n}{3} \rfloor$. Because finding the optimal set of guards is NP-hard, approximation algorithms are commonly used to generate a solution. We propose a novel approach that uses deep learning. More precisely, we use pointer networks, a specialized type of neural network designed to select a subset of some set based on certain criteria. We implemented a recurrent neural network, that trains slowly, but is fast in generating guards, and a Transformer network, that trains rapidly, has more parameters, but is somewhat slower in generating guards. In this talk we will present deep learning techniques that allow us to solve this problem, and the corresponding results.

Keywords: Computational geometry, Art gallery problem, Pointer networks