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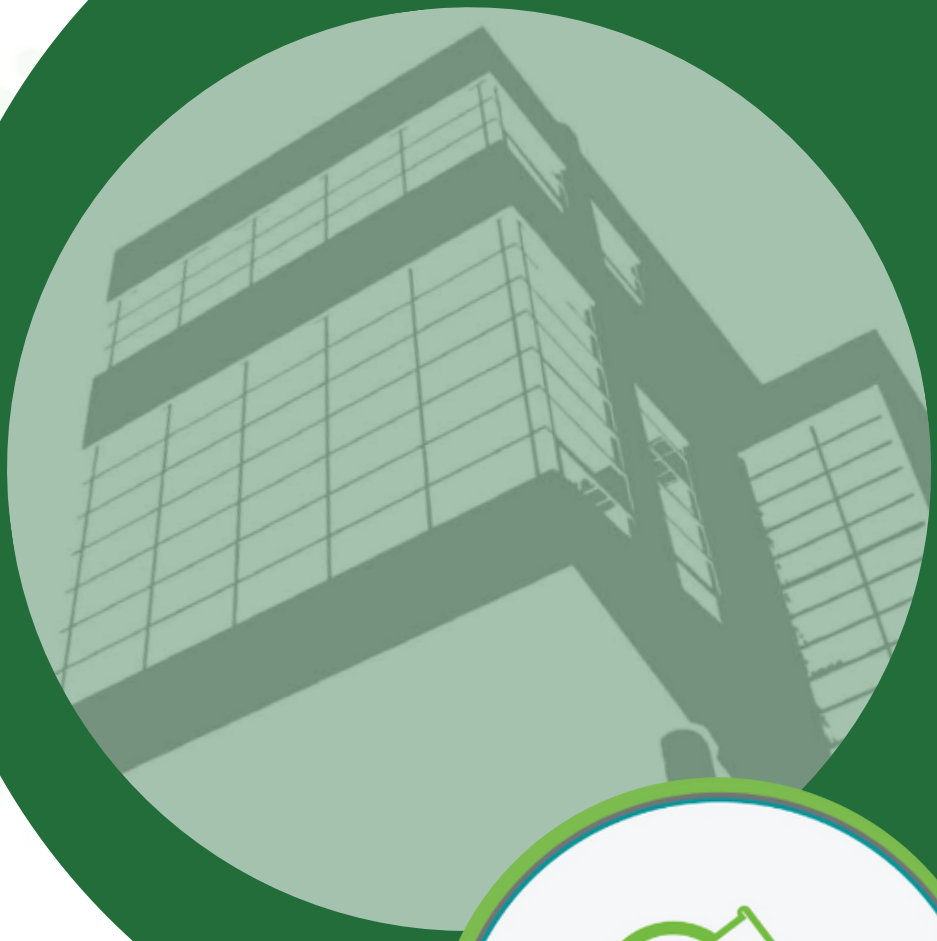

4th YOUNG SCIENTISTS' DAY

Faculty of Agrobiotechnical Sciences Osijek

BOOK OF ABSTRACTS

ORGANISERS

Young Scientist's Day

Young Scientist's Conference

October 7th 2022, Osijek, Croatia

BOOK OF ABSTRACTS

Znanstveni skup mladih istraživača

07. listopada 2022. godine, Osijek, Hrvatska

KNJIGA SAŽETAKA

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Department of Chemistry (University of Osijek)

Young Scientist's Day

PROGRAM

CONFERENCE PROGRAMME

07. listopada 2022. godine, Osijek, Hrvatska
October 7th 2022, Osijek, Croatia

08:30h - 09:00h - Registracija sudionika
Registration of participants

09:00h - 09:30h - Otvaranje skupa
Opening of the meeting

Pozdravna riječ:

Prof. dr. sc. Vlado Guberac, rektor Sveučilišta Josipa Jurja Strossmayera
Prof. dr. sc. Sonja Vila, prorektorica za znanost, tehnologije, projekte i međunarodnu suradnju Sveučilišta Josipa Jurja Strossmayera
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Prof. dr. sc. Zvonko Antunović, prodekan za znanost i poslijediplomske studije Fakulteta agrobiotehničkih znanosti Osijek

09:30h - 10:20h - Prva sekcija predavanja
First section of lectures

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

09:30h - 09:40h

Dejan Bošnjak
"Optimizacija mikropropagacije borovnice (*Vaccinium corymbosum* L.) primjenom nanobiotehnologije u tekućem imerznom (TIB/TIS) sustavu bioreaktora" / "The Optimization of Blueberry Micropropagation (Vaccinium corymbosum L.) Using Nanobiotechnology in Liquid Immersion (TIB/TIS) Bioreactor System" - **Faculty of Agrobiotechnical Sciences Osijek**

09:40h - 09:50h

Josipa Puškarić
"Nematode kao bioindikatori stanja ekosustava tla u konsocijaciji drvenastih vrsta i poljoprivrednih kultura" / "Nematodes as bioindicators of the state of the soil ecosystem in the association of woody species and agricultural crops" - **Faculty of Agrobiotechnical Sciences Osijek**

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Sanja Jelić Milković
"Utjecaj društvenih zahtjeva na potrošački odabir mesa crne slavonske svinje"/ "Impact of social concerns on consumer choice of Black Slavonian Pig meat" - **Faculty of Agrobiotechnical Sciences Osijek**

10:00h - 10:10h
Blanka Bilić Rajs
"Određivanje zemljopisnog podrijetla hrvatskog meda pomoću stabilnih izotopa, mineralnih tvari i kemometrije" / "Geographical Origin Determination of Croatian Honey by Using Stable Isotopes, Mineral Elements and Chemometrics" - **Faculty of Food Technology Osijek**

10:10h - 10:20h
Jozo Ištuk
"Utjecaj β-glukana na bioraspoloživost polifenola voća ispitivanjem kinetičkih modela simuliranih probavnih procesa" / "β-glucan influence on the fruit polyphenol bioaccessibility by studying kinetic models of simulated digestive processes" - **Faculty of Food Technology Osijek**

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Break

10:30h - 11:20h - Druga sekcija predavanja

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Silvija Šafranko
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Nenad Čekić
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Robert Mujkić
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Ana Vuković
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13:00h - 13:10h

Andrea Dandić
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Dalibor Tatar
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Closing the meeting

13:30h - Ručak za aktivne sudionike
Lunch for active participants

SAŽETCI IZLAGANJA

PRESENTATION ABSTRACTS

Optimizacija mikropropagacije borovnice (*Vaccinium corymbosum* L.) primjenom nanobiotehnologije u tekućem imerznom (TIB/TIS) sustavu bioreaktora

The Optimization of Blueberry Micropropagation (*Vaccinium corymbosum* L.) Using Nanobiotechnology in Liquid Immersion (TIB/TIS) Bioreactor System

D. Bošnjak[1]

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**corresponding author: dbosnjak@fazos.hr*

Temporary Immersion Bioreactor System (TIB/TIS) is a fully controlled, modular biotechnical system that uses a liquid nutrient medium without agar addition. One of this system's existing problems, however, is the emergence of vitrification (hyperhydricity). The research is based on growing condition optimization in blueberry (Vaccinium corymbosum L.) micropropagation by a TIB/TIS system (SETISTM), with the aim to reduce a harmful vitrification while applying SiO2 and ZnO nanoparticles and phloroglucinol as a plant growth regulator. The experiment was conducted at the Faculty of Agrobiotechnical Sciences Osijek during the years 2020 and 2021. Liquid nutrient medium contained the micro- and macroelements of the WPM medium (pH 5.0), with the addition of 30 g/L-1 of sugar, 2 mg/L-1 of zeatin, and 2 ml/L-1 of PPM. The experiment included a control variant, four treatments using different nanoparticles (30 and 74 mg/L-1 of nano-SiO2 and 1 and 10 mg/L-1 of nano-ZnO, respectively), two treatments of plant growth regulator (40 and 80 mg/L-1 of phloroglucinol), and four treatments of individual nanoparticle combinations with the plant growth regulator. At the end of the cultivation period, a significant effect of the treatment was determined for the vitrification index, leaf anatomy, morphological parameters, nutrient medium stability, mineral nutrition elements' bioaccumulation, and the blueberry plants' physiological ‑ biochemical response. The vitrification index was in the range of 10 % to 40 %. By analyzing the vitrified plant material (40 %), a large deviation from a correct arrangement and structure of the leaf mesophyll cells was detected. Nano-SiO2 treatments significantly reduced the stomata number. The application of nano-SiO2, as well as the lower phloroglucinol levels, did not affect an increase in the total chlorophyll and carotenoid content. A physiological ‑ biochemical response to the application of nano-SiO2 did not exert a stressful effect on the plants. The content of total chlorophyll and carotenoids, total phenols, antioxidant activity, and ascorbic acid are at the level of control treatment, with a positive effect exerted on certain morphometric parameters, productivity, and vitrification index. The research results indicate a potential of using SiO2 nanoparticles, as well as the phloroglucinol plant regulator, in suppressing the blueberry shoots' vitrification in the TIB/TIS bioreactor under the growing conditions on a liquid nutrient medium. A protocol improvement imposes a necessity to determine the more precise concentrations and silicon forms and to determine phloroglucinol as an optional reagent model in a subsequent sub ‑ cultivation phase.

Keywords: TIB/TIS system, blueberry, vitrification/hyperhydricity, nanoparticles, phloroglucinol

Utjecaj ekosustava konsocijacije stabala oraha i poljoprivrednih usjeva na bioraznolikost nematoda i strukturu zajednice nematoda u tlu
The effect of walnut trees and agricultural crops in intercropping ecosystem on nematode biodiversity and nematode community structure in the soil

J. Puškarić[1*], V. Ivezić[1], B. Popović[1], M. Brmež[1]

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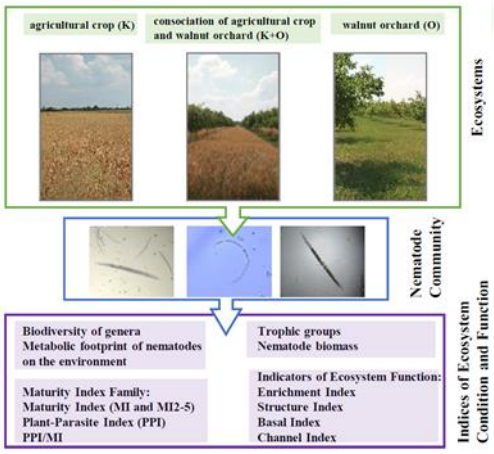

Soil nematodes are sensitive to human intervention and are often used as biological indicators of disturbance, soil quality and health. The objective of this study was to determine the effects of walnut trees and agricultural crops in intercropping ecosystem on soil nematode biodiversity, nematode community structure, and indices of the ecosystem health and function. The experiment was conducted in three different ecosystems, intercropping of agricultural crops and walnuts (C+W), agricultural crops (C) and walnut orchards (W). Abundance, biomass and biodiversity of nematode genera were highest in the ecosystem C+W. Bacterivores were identified as the dominant trophic group in the nematode community in all ecosystems studied, with Acrobeloides, Heterocephalobus and Rhabditidae being the most abundant. The highest percentage of bacterivores was found in ecosystem C. The highest percentage of fungivores was found in ecosystem W, and the dominant genera were Aphelenchoides and Aphelenchus. The percentage of phytoparasitic nematodes was highest in ecosystem O. The predominant genus of phytoparasitic nematodes was Pratylenchus, followed by Tylenchus, Malencus, Paratylenchus, and Helicotylenchus. The highest percentage of omnivores was found in ecosystems W and C+W. The genus Aporcelaimellus was the dominant omnivore in ecosystem C, and the genera Epidorylaimus, Mesodorylaimus, Prodorylaimus, and Pungentus were dominant in ecosystems W and C+W. There were no significant differences between the percentages of predators in the different ecosystems, but the dominant genera were Anatonchus and Clarkus. The high species diversity of nematodes is of great importance for soil health, especially the species diversity of beneficial nematodes, omnivores, bacterivores and fungivores, as they play a very important role in the soil. The results indicate a positive influence of walnut trees and agricultural crops in intercropping ecosystems on soil health and ecosystem stability, which is of great importance because soil health is one of the basic requirements for successful agricultural production.

Keywords: bacterivores, fungivores, phytoparasites, omnivores, predators

Utjecaj društvenih zahtjeva na potrošački odabir mesa crne slavonske svinje
Impact of social concerns on consumer choice of Black Slavonian Pig meat

***S. Jelić Milković*[1,*], *R.Lončarić*[1], *M. Canavari*[2]**

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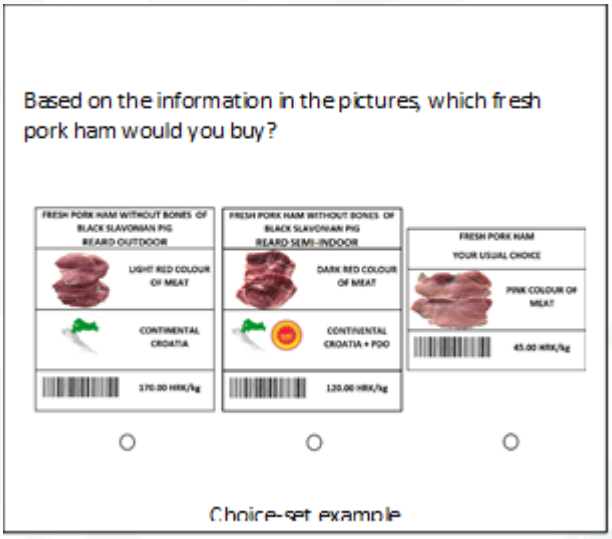

The main objective of the dissertation was to obtain an overview of consumers attitudes and beliefs towards some aspects related to social concerns (sustainability, biodiversity and rural development, and animal welfare) and examine influence of information (about production system, colour, geographical information) on consumer choice in favour of local pig breeds, in this case, the Black Slavonian Pig breed, but also to provide knowledge support to producers, national agricultural food policy makers and retailers. Croatian consumers were randomly assigned to one of two treatment options (control or information) in an online survey. Consumers (n = 410) answered questions about their purchase intentions, perceptions and beliefs. A hypothetical choice experiment was used to examine participants' preferences and willingness to pay (WTP) for fresh meat of the Black Slavonian Pig breed reared outdoors and semi-indoors. The results show that the consumers have a notable preference for fresh boneless ham (*Gluteus Medius*) from the Black Slavonian Pig produced in both production systems and labelled as reared in continental Croatia + PDO (Protection of Designation Origin) compared to fresh boneless ham produced from pigs reared in conventional rearing system (intensive – indoor) without a label. Information treatment also proved to be important, as the results show that the information given to the consumers about the production system (that is in line with animal welfare, environmental protection and preservation of biodiversity) meat colour and geographical information positively influenced the consumers' decisions giving great importance to investigated social concerns regarding sustainability, preservation of biodiversity and animal welfare. It is evident that appropriate labelling and information on the product could positively influence consumer preferences, indicating the importance of highlighting the traditional characteristics (production system, darker colour of the meat and production area) of fresh meat from the Black Slavonian Pig on the label in promotional activities.

Keywords: consumer preferences, fresh meat, Black Slavonian Pig, choice experiment

ORAL PRESENTATION

Određivanje zemljopisnog podrijetla hrvatskog meda pomoću stabilnih izotopa, mineralnih tvari i kemometrije
Geographical Origin Determination of Croatian Honey by Using Stable Isotopes, Mineral Elements and Chemometrics

***Blanka Bilić Rajs*[1*], *Ivana Flanjak*[1], *Dušanka Milojković-Opsenica*[2], *Živoslav Tešić*[2], *Ljiljana Primorac*[1]**

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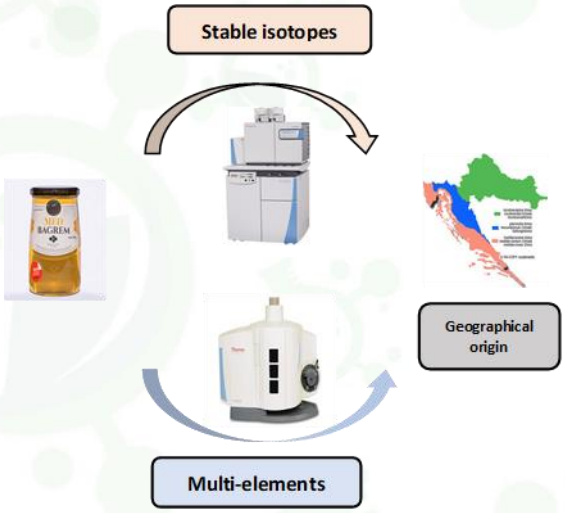

Honey is valuable bee product mainly composed of carbohydrates (fructose and glucose, 65-75%) and water (15-20%), while other components which are present in small amounts are responsible for sensory and nutritive honey characteristics. For many years honey is recognised as a high-quality food which is why it is often subject of adulteration (addition of sugar syrups, mislabelling of botanical and geographical origin). Considerable efforts are being made to find new analytical methods for assessing honey authenticity. One of the newer analytical approaches in determination of botanical and geographical origin of honey is usage the combination of stable isotopes and mineral composition together with chemometrics.

The aim of this work was to examine weather is possible to distinguish honey samples of the same botanical origin collected in two different geographical regions of Croatia (continental and coastal) by using stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratio and mineral composition. Lime (*Tilia* spp.) and black locust (*Robinia pseudoacacia* L.) honey samples were collected in beekeeping season 2014 and 2015, respectively. Stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) in honey and isolated honey proteins were determined by elemental analyser isotope ratio mass spectrometer (EA-IRMS). Mineral elements (Al, As, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, P, Pb, S, Zn) were determined by inductively coupled plasma - optical emission spectrometry (ICP-OES) with previous microwave digestion of the samples. Results of the PCA analysis showed that 87% of black locust honey samples from two regions were distinguished by using only IRMS parameters, while in combination with ICP parameters classification success was 100%. Lime honey samples were successfully classified according to region of origin by using only IRMS parameters. Combination of IRMS and ICP parameters together with PCA analyses could be useful tool in assessing honey geographical origin.

Keywords: honey, geographical origin, stable isotopes, mineral composition, PCA

Utjecaj β-glukana na bioraspoloživost polifenola voća ispitivanjem kinetičkih modela simuliranih probavnih procesa

β-glucan influence on the fruit polyphenol bioaccessibility by studying kinetic models of simulated digestive processes

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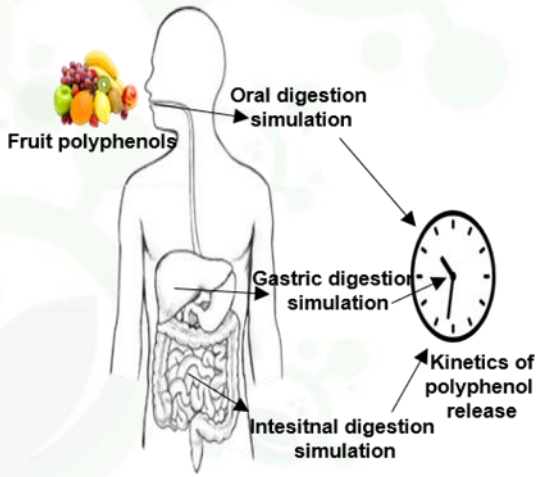

This study aimed to examine the bioaccessiblity of fruit polyphenols and the effect of β-glucan on bioaccessibility. An in vitro simulation of peel and flesh digestion of fruits of traditional and commercial apple cultivars (*Malus domestica* Borkh.) and black elderberry (*Sambucus Nigra* L.) was performed, without and with the addition of β-glucan. Experimental data (amount of polyphenols released during digestion (c_t) as a function of time (t)) were analysed by kinetic equations. Polyphenols become available for absorption in the digestive system in amounts that are significantly lower than those present in fruit before digestion. After digestion in the mouth, the amount of total polyphenols released in the stomach showed a significant increase and decreased significantly after digestion in the small intestine. Polyphenolic classes showed different behaviours during simulated digestion. After the oral phase, the amount of all polyphenolic classes showed a significant increase after gastric digestion. After small intestine digestion anthocyanins and flavan-3-ols completely disappeared or showed a significant reduction, phenolic acids and dihydrocalcones showed a significant reduction, while the amount of flavonols was similar. β-glucan reduced the amount of polyphenols released, which was statistically significant in some cases. First and second order equations were modified and adjusted for the characteristic release and degradation of polyphenols during simulated digestion. Nonlinear regression of ct data as a function of t modified by the first order equation showed a smaller standard error compared to the second or zero order reactions. Simulated digestion of polyphenolic classes in the stomach and small intestine follows first-order kinetics with a half-reaction time within 10 minutes of the process duration. β-glucan plays a potentially important role in the bioaccessibility of polyphenols and the amount that reaches the lower parts of the digestive system which is important for the various positive bioactivities of polyphenols. The modified kinetic equations used for the first time in this paper can be applied in further studies of polyphenol bioaccessibility

Keywords: polyphenols, bioaccessibility, β-glucan, digestion simulation, kinetics

Priprema i karakterizacija N-dopiranih/hibridnih ugljikovih kvantnih točaka i njihova primjena u detekciji metalnih iona

Preparation and Characterization of N-Doped/Hybrid Carbon Quantum Dots and Their Application in Metal Ion

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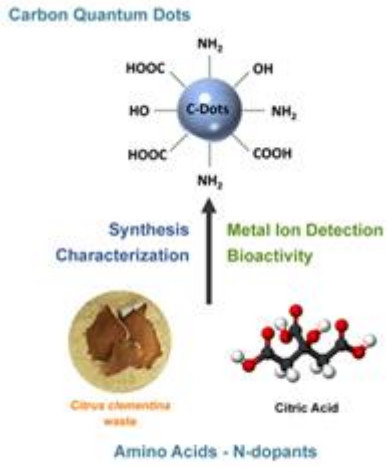

Carbon quantum dots (CQDs) represent a new class of efficient carbon photoluminescent nanomaterials that have attracted the attention of many scientists over the past decade, especially due to their excellent chemical and optical properties. In general, carbon dots are defined as zero-dimensional carbon-based nanoparticles with a diameter less than 20 nm, while the specific applicability mostly depend on the nanoparticle size, shape, composition, and surface features. Their high chemical and photo-stability, biocompatibility/low toxicity, tunable emission, water solubility and optical efficiency represent a huge potential for a wide range of applications in biomedical research and nanotechnology. This work presents a comparative study of the CQDs preparation from *Citrus clementina* peel and citric acid. In order to obtain best performing hybrid nanoparticles (CQD@hybrid), pre-optimization regarding synthetic conditions, type and quantity of added amino acids has been performed. The main aim of this study was to enhance quantum yield (QY) of prepared samples, also to improve their bioactivity, and to achieve selective response toward Fe^{3+} ions. The highest quantum yield was determined with CQD@hybrid obtained with the addition of amino acid leucine (Leu), treated at temperature of 200°C for 12 hours, and this sample was further investigated for the Fe^{3+} ion sensing. The developed model was described by an exponential function with a suitable coefficient of determination of $R^2 = 0.9851$, while the linear range was determined in the concentration range from 0.5 μmol dm^{-3} to 15 μmol dm^{-3} with a determined limit of detection of LOD = 2.72 ± 0.39 μmol dm^{-3} and limit of quantification of LOQ = 9.06 ± 1.29 μmol dm^{-3}. The developed model has been tested for the Fe^{3+} ions detection in real sample systems of well water samples. These presented results are indicative of a good preparative approach toward obtaining highly fluorescent CQDs, showing also good stability in aqueous media with significant differences in optical properties, while showing great potential for the studies in biological systems and water monitoring.

Keywords: *Carbon quantum dots, nanoparticle functionalization, metal ion detection, bioactivity*

Utjecaj prehrane majke i međugeneracijske izmjene tipa prehrane na morfologiju jajnika potomaka štakora

Influence of maternal diet and intergenerational change in diet type on ovarian morphology in rat offspring

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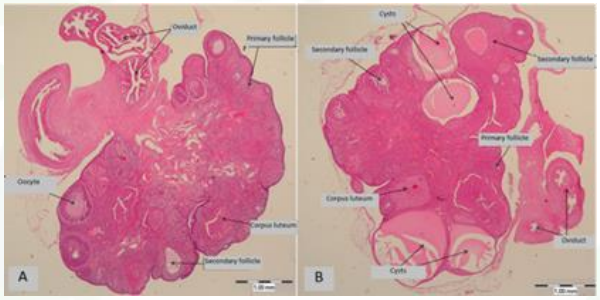

Maternal diet can influence functioning of different organ systems in offspring. The aim of this study was to determine how the diet of mothers and offspring affects the morphological characteristics of ovaries in Sprague Dawley rats. One group of Sprague Dawley rats fed standard laboratory food and the other group fed food rich in saturated fatty acids. All rats were then mated with the same male. After pregnancy and lactation, female offspring of both groups of mothers were divided into two groups, so that one group was fed standard laboratory food and the other food rich in saturated fatty acids for 22 weeks. Rats were sacrificed, their ovaries were isolated, weighted, embedded in paraffin blocks and histological sections were prepared. The presence of cystic formations, the percentage of collagen in the ovarian stroma was determined in the ovaries, and after immunohistochemical staining, the number of CD68 positive cells and the intensity of immunohistochemical staining for TNF-α in ovarian tissue were determined. Ovarian weight was higher in the offspring of the mothers fed food rich in saturated fatty acids and in the same groups cystic formations and a higher percentage of collagen in the ovaries were observed. A higher number of CD68 positive cells and a stronger intensity of immunohistochemical staining for TNF - α was demonstrated in offspring fed food rich in saturated fatty acids. It can be concluded that maternal nutrition affects ovarian weight, the incidence of cystic formations in the ovaries and ovarian fibrosis. The diet of the offspring affects the number of macrophages and the intensity of the immunohistochemical signal TNF - α.

Keywords: high – fat diet, immunohistochemistry, ovary, rat

Komparacija radioloških metoda u procjeni invazije karotidnih arterija u pacijenata s malignim tumorom glave i vrata
Comparison of radiological methods in the assessment of invasion of carotid arteries in patients with malignant tumors of the head and neck

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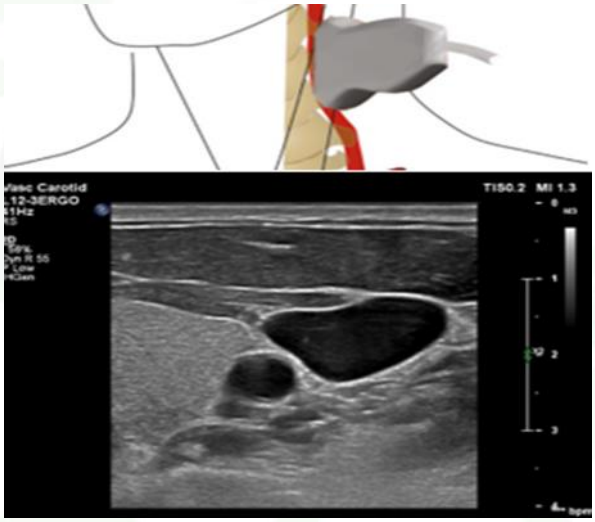

Invasion of the carotid artery wall remains by spread from the primary tumor or by extracapsular spread from the metastatic lymph node. Tumor invasion of the carotid artery wall is a significant prognostic factor. According to the American Joint Committee on Cancer criteria, patients with an infiltrated carotid artery are inoperable, but a potential resection can be selectively considered. Therefore, the assessment of carotid artery invasion is valuable for the decision on further treatment. The radiological methods for assessing tumor invasion of artery walls are CT and MRI, but they are demanding and insufficiently reliable. Ultrasound monitoring of wall mobility artery has not been investigated yet. The advantage of ultrasound is safety, availability, does not use ionizing radiation and lower price. Aim of study are to determine the mobility of the artery wall close to metastatic lymph node using ultrasound. This study included 22 carotid arteries from patients with malignant disease of head who underwent a CT scan on which metastatic lymph nodes and infiltration of the artery wall were described. Then the mobility of infiltrated part of the artery wall was monitored by ultrasound, which showed that the infiltrated part of the artery wall has decreased, or absent mobility compared to the non-infiltrated part of the wall. Comparison of these two methods in the assessment of wall artery invasion showed a strong correlation. US assessment of mobility is as valuable in the assessment of vessel wall invasion as CT standardized parameters. Further research is in the direction of applying artificial intelligence algorithms for the analysis of ultrasound images to further increase the diagnostic accuracy by recognizing unused information contained in the images. With their quantification, ultrasound examination can become the method of choice for assessing tumor invasion of the carotid artery wall.

Keywords: ultrasound, computer tomography, artery mobility, tumor head and neck, artificial intelligence

Pozitivni učinci konzumacije funkcionalno obogaćene hrane na mikrocirkulaciju zdravih mladih ispitanika
Positive effect of consumption of functionally enriched food on microcirculation of healthy young subjects

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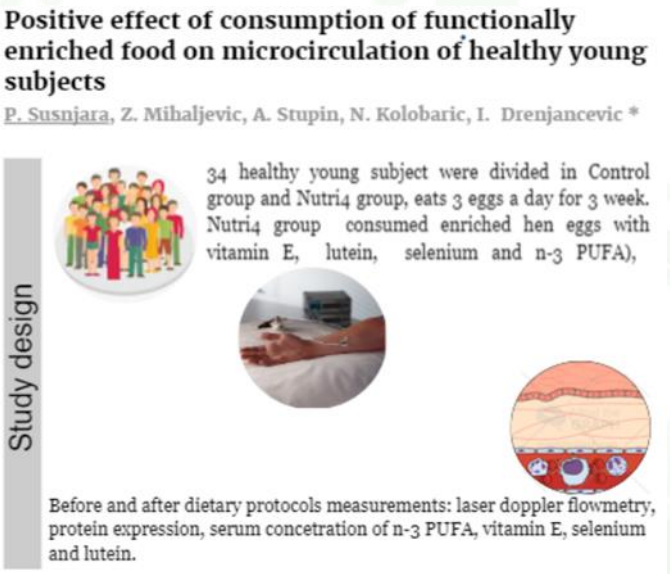

Unbalanced and nutritionally poor diet leads to increased risk of endothelial dysfunction and other cardiovascular diseases, while optimal diet contributes to health and normal function of the endothelium. Aim of this study is to determine the effects of consumption of enriched hen eggs on microcirculation of healthy young subjects using Laser doppler flowmetry (LDF). This was a randomized, double-blind, placebo-controlled interventional study (part of ID: NCT04564690, the study was registered on the clinicaltrial.gov). Subjects were divided in Control group (n=14; consumed regular hen eggs (1.785 mg of vitamin E, 0.330 mg of lutein, 0.054 mg of selenium and 438 mg of n-3 PUFAs daily), and Nutri4 group (n=20) who consumed enriched eggs (daily in total approximately 3.29 mg of vitamin E, 1.85 mg of lutein, 0.06 mg of selenium and 1026 mg of n-3 PUFAs), 3 eggs a day for 3 weeks. Before and after dietary protocols microvascular flow of the forearm skin (endothelium-dependent responses: post-occlusive reactive hyperemia (PORH) and iontophoresis of acetylcholine - AChID and sodium nitroprusside SNPID (endothelium-independent response endothelium)), protein expression of enzymes (COX1, COX2, iNOS, eNOS and nNOS), serum concentrations of n-3 PUFAs, vitamin E, selenium and lutein were measured. PORH and AChID were significantly enhanced while SNPID remained unchanged, protein expression of COX2 was significantly higher in the NUTRI4 group while other analytes remained unchanged. Serum concentrations of n-3 PUFAs, vitamin E and lutein were significantly higher in the Nutri4 group while selenium remained unchanged compared to pre-diet values. The consumption of enriched hen eggs have positive affects on microvascular reactivity, and this changes can be attributed to the positive effect of vasoactive COX2 metabolites and increased serum concentration of n-3 PUFAs, vitamin E and lutein.

Keywords: functionally food, n-3 PUFA, vitamin E, selenium, lutein, microcirculation

Molekularni mehanizmi renalnog učinka SGLT2 inhibitora na staničnom modelu proksimalnih tubularnih stanica
Molecular mechanisms of renal effect of SGLT2 inhibitor on cellular model of proximal tubular cells

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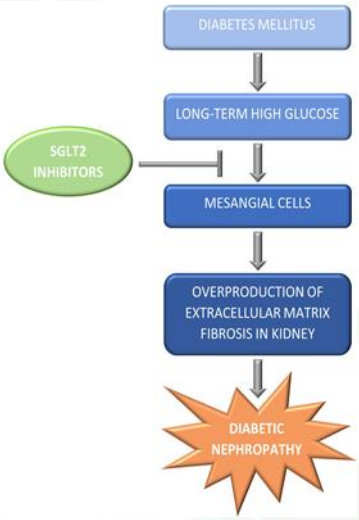

Diabetic nephropathy (DN) is a chronic complication of diabetes that often leads to end-stage renal disease. High glucose (HG) concentrations can directly stimulate cell proliferation and collagen synthesis in human proximal tubular cells and cortical fibroblasts, detached of glomerular, hemodynamic or vascular pathology. The aim of this study was to investigate the effects of empagliflozin (SGLT2i) on cell viability, oxidative stress, and collagen synthesis in an LLC-PK1 model of diabetic nephropathy. Cells were exposed to high glucose (HG30 mM) followed by 0.5 mM H2O2 and a combination of glucose and H2O2 for 24 hours. Cells were treated with various combinations of glucose and empagliflozin (100 and 500 nmol L-1) and combinations of glucose, H2O2, and empagliflozin. The colorimetric MTT assay was used to determine cell viability. Concentrations of glutathione (tGSH), ECM expression, and TGF-β1 were measured using a spectrophotometric/microplate assay and an ELISA kit, respectively. After initial exposure of cells to glucose and oxidative stress, addition of both concentrations improved cell viability and also increased the accumulation of GSH concentration ($p < 0.001$, $p < 0.05$). The addition of 500 nM empagliflozin significantly increased collagen synthesis in cells treated with HG30 compared to cells treated with HG30 alone ($p < 0.01$), while the addition of 100 nM empagliflozin had no effect. In addition, empagliflozin treatment caused a decrease in TGF- β1 levels in both concentrations of injured cells ($p < 0.001$). Empagliflozin appears to have a protective effect against renal injury based on cellular viability. The ability of empagliflozin to reduce oxidative stress and its antifibrotic abilities are the main mediators of its renoprotective effects.

Keywords: diabetic nephropathy, LLC-PK1 cell culture, Empagliflozin

Proupalni i remodelacijski procesi u subkutanom i visceralnom masnom tkivu definirani kroz aktivnost imunometaboličkih adipocitokina kod muške djece i adolescenata
Proinflammatory and remodeling processes in subcutaneous and visceral adipose tissue defined through the activity of immunomodulatory adipocytokines in male children and adolescents

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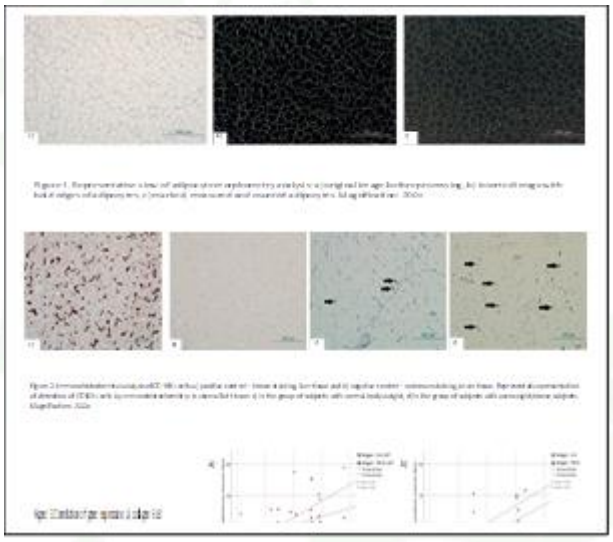

Childhood obesity is a serious public health problem that leads to numerous metabolic diseases which significantly affect quality of life. Aim of this study was to examine the processes affecting remodeling of the extracellular matrix (ECM) in adipose tissue of healthy male children depending on their body weight. Subcutaneous adipose tissue (SAT) and visceral adipose tissue (VAT) samples were collected from 75 healthy male subjects who underwent elective orchidopexy or hernia repair. Subjects were divided into two groups depending on their BMI Z-score. Analysis of adipose tissue morphometry was performed by histological staining method hematoxylin and eosin and the assessment of fibrosis in ECM of adipose tissue was performed by Massons's trichrome staining method for collagen detection; immunohistochemistry was performed for determining the number of $CD163^+$ cells and detection of crown like structures (CLS); ELISA was performed for determination of serum adipocytokine levels for - chemerin, visfatin, adiponectin and omentin. rtPCTR was performed for relative gene expression for – *IL-6*, *IL-8*, *TNF-α* and *COL6α3* on 20 samples. Overweigth and obese subjects were found to have larger surface area adipocytes in SAT, higher number $CD163^+$ cells in VAT, higher number of CLS in both adipose tissue depots, higher collagen staining in VAT and significantly higher gene expression of COL6α3 in both depots and higher gene expression of IL-8 and IL-6 in SAT. Overweight and obesity was positively correlated with larger surface area in SAT, higher number of adipocytes in VAT, $CD163^+$ cells and CLS in both depots of adipose tissue. In male children, obesity can lead to SAT adipocyte hypertrophy, increase collagen deposition in VAT, increase COL6α3 expression and promote changes in macrophage polarization, affect their accumulation, structural stability of the ECM and the development of inflammation.

Keywords: obesity; early years; collagen; inflammation; macrophages; adipose tissue

Sindrom pekućih usta- akupunktura kao alternativni pristup u terapiji
Burning mouth syndrome- acupuncture as a alternative therapeutic approach

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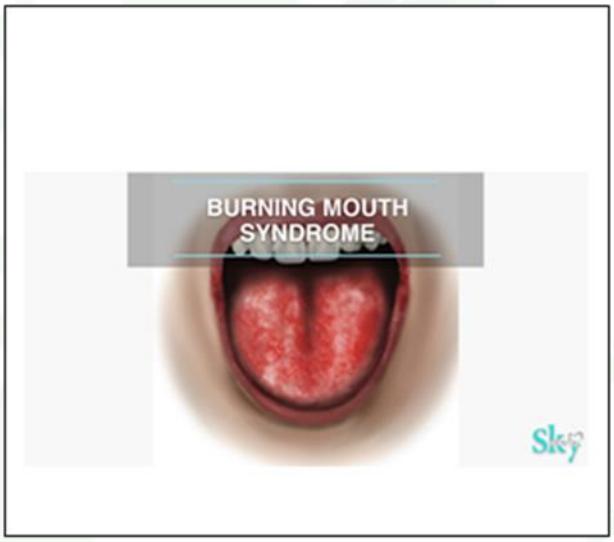

Despite the numerous investigations, burning mouth syndrome (BMS) is still enigmatic condition which frustrates both clinicians and patients and is characterized by burning in the oral cavity, mostly on the tongue. Burning mouth syndrome is thaught to be caused by peripheral and/or central neuropathic disturbances. As seen in other neuropathic conditions within oral cavity, so far available therapeutic possibilities are not sufficient in some patients with BMS, therefore need for alternative therapies as acupuncture is searched.

Keywords: *burning mouth syndrome, stomatopyrosis, stomatodynia, therapeutic approach, acupuncture*

Biokemijski i molekularni mehanizmi odgovora klijanaca pšenice na selen

Biochemical and molecular mechanisms of wheat seedlings response to selenium

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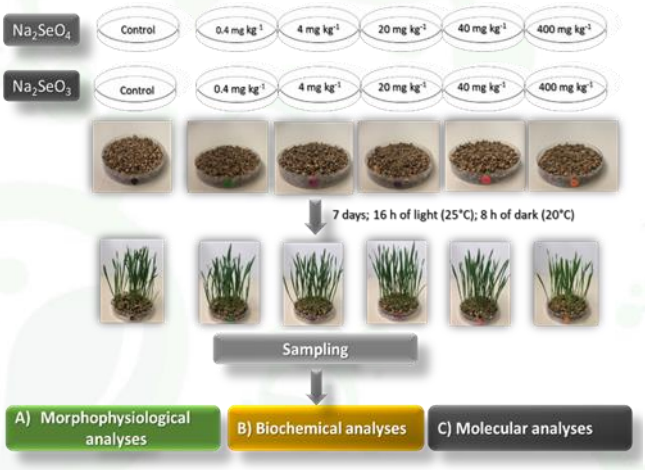

Selenium (Se) deficiency in human and animal nutrition is primarily due to low levels of Se in soils. It can be prevented by enriching crops, such as wheat, with Se by genetic and agronomic biofortification. Although Se is not essential for plants, it shows a double effect on their metabolism. This study aimed to elucidate the impact of five different concentrations (0.4, 4, 20, 40 and 400 mg kg^{-1}) of selenate and selenite on the oxidative status and detoxifying systems of wheat (*Triticum aestivum* L., cv. Kraljica) shoots and roots and to determine biochemical and molecular tissue-specific responses. According to morpho-physiological analyses, selenite was found to have a lower toxicity threshold than selenate. Measurement of oxidative stress biomarkers showed that Se did not cause oxidative damage to wheat seedlings due to activation of detoxification mechanisms at the biochemical and molecular level, which depended on the type of tissue, concentration and form of applied Se. These results contribute to a better understanding of wheat seedlings' physiological, biochemical, and molecular response to Se and the development of more effective biofortification strategies.

Keywords: *selenium, biofortification, wheat, detoxification mechanism*

Utjecaj binarnih mješavina triazolnih fungicida na ponašanje *Daphnia magna*

The effects of triazole fungicide binary mixtures on behaviour of *Daphnia magna*

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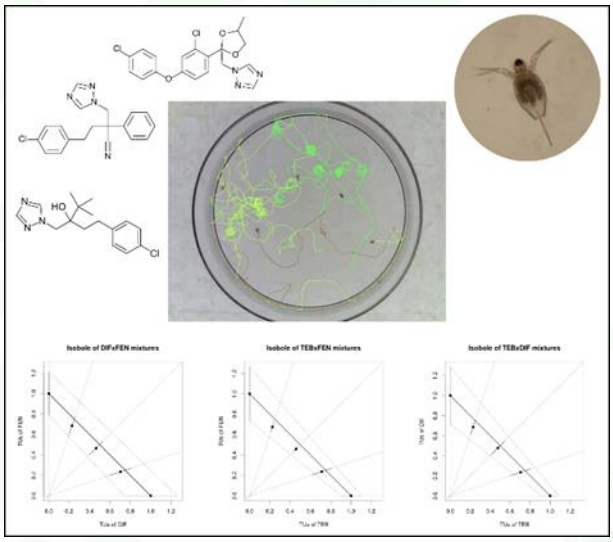

The widespread use of pesticides in agriculture results in contamination of soil and water, and leads to adverse effects on non-target organisms. Cladocerans, especially daphnids, are an important component of aquatic ecosystems, linking primary producers to higher trophic levels. Due to their high sensitivity to toxicants, short life cycle and simple handling, they are commonly used model organisms in ecotoxicological research. So far, the effects of a wide range of pesticides on swimming activity of *Daphnia* species has been investigated. However, research on the effects of binary mixtures on behavioral endpoints of daphnids is very limited. The aim of this research was to assess the effects of binary mixtures of three triazole fungicides (tebuconazole, difenoconazole and fenbuconazole) on average swimming speed of *Daphnia magna*. *D. magna* neonates were hatched from ephippia by following the Daphtoxkit F instructions. Mixture experiments were conducted following a fixed-ratio ray design, by employing the equal effect concentration ratio approach. Mixtures of the chosen triazole fungicides were prepared based on EC50 values for average swimming speed after a 24-h exposure for single compounds. Single substances were mixed in ratios corresponding to five effect ratios, following the isobole method. No statistically significant differences from the additive effect were found in any of the mixtures tested. The results of this research indicate that movement parameters are sufficiently sensitive endpoints that can be used as a basis for designing experiments and proving the sublethal effects of binary mixtures on organisms.

Keywords: *swimming speed, isobolograms, trajectories, video analysis*

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Potraga za narušenjem Lorentzove simetrije Čerenkovljevim teleskopima

Searches for Lorentz invariance violation with imaging atmospheric Cerenkov telescopes

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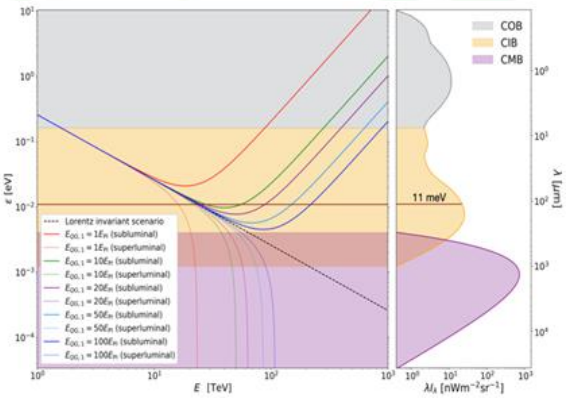

Some candidates for the theory of quantum gravity allow Lorentz invariance violation (LIV). Possible deviations from the Lorentz symmetry affect interaction and propagation of the very high-energy gamma rays (VHE, >100 GeV) through space-time. These effects of quantum gravity, if they exist, are minuscule. However, they can accumulate over large distances. Therefore, they could leave a trace on the spectrum and light curve of VHE gamma rays emitted from various astronomical sources, traveling up to billions of light-years from their point of emission to the Earth. Currently, there are two main lines of LIV studies with imaging atmospheric Cerenkov telescopes (IACTs). The *Universe transparency* (UT) method investigates how the change of the reaction energy threshold (due to LIV) is changing the spectrum of the observed source. On the other hand, the *Time of flight* (ToF) method investigates the influence of LIV on the photon speed. The most stringent constraints for ToF method up-to-date are $2.2 \cdot 10^{19}$ GeV ($3.9 \cdot 10^{19}$ GeV) for linear subluminal (superluminal) case and $8.5 \cdot 10^{10}$ GeV ($7.3 \cdot 10^{10}$ GeV) for quadratic subluminal (superluminal) case. On the other hand, the most stringent constraints for UT method up-to-date for subluminal scenario are $6.9 \cdot 10^{19}$ GeV for linear and $1.6 \cdot 10^{12}$ GeV for quadratic case. In this presentation, we will present the development of the gLike code for LIV searches. gLike is an open-source, ROOT-based code framework for numerical maximization. Originally it was developed for dark matter signals searches. Due to the modularity of the original code, extension to LIV studies is possible. Our goal is to implement two different analysis methods: an unbinned likelihood and a binned likelihood. We will also discuss some suitable data sets for the LIV studies, such as the flare of BL Lac detected by MAGIC telescopes in September 2020 and August 2021.

Keywords: *Lorentz invariance violation, imaging atmospheric Cerenkov telescopes, very-high energy gamma-rays, quantum gravity*

Tumačenja i povratne informacije nastavnika na učenička objašnjenja
Teachers' interpretation and response to students' explanations

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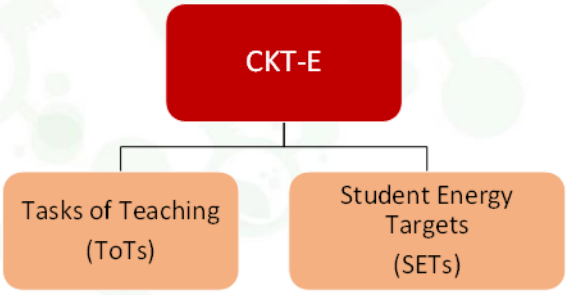

To help students learn teachers need to be able to recognize students' strengths and weaknesses and give feedback in real time. This feedback needs to address the students' strengths and weaknesses, and it has to build on the students' existing knowledge. Such skills are a part of teachers' content knowledge for teaching (CKT) framework created by Ball and colleagues for teaching of mathematics. Etkina and colleagues extended the model of CKT to the domain of physics, specifically energy – CKT-E. This model includes two components: Tasks of teaching (ToTs) and Student Energy Targets (SETs). ToTs represent activities which teachers do while helping students learn any content, and SETs represent important disciplinary ideas, science practices and cross-cutting concepts important for student learning of energy. The goal of the study reported here is to use the ToTs framework to analyse teachers' responses to student ideas and to answer the following research questions:

1. How do teachers interpret productive and problematic aspects of student explanations?
2. How do teachers' interpretations compare to the interpretations of physics education experts?
3. What is the difference between answers to Questions 1-2 for in-service and pre-service teachers?

Student work consisted of solutions to a multiple-choice problem involving both conservation of momentum and energy where students were asked to explain their choices. The survey administered to teachers contained the text of the problem and each student's written explanation of their answer choice. The participants were asked to comment on the student's strengths and weaknesses and to provide their hypothetical response to the student. We use a subset of the Tasks of Teaching to develop a descriptive coding scheme to analyse teacher responses. To answer research questions, we provide qualitative and quantitative analysis of teacher responses and document the differences between response patterns of in-service teachers and pre-service teachers.

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

Perovskitne heterostrukture i primjene u solarnim ćelijama
Perovskite heterostructures and solar cell applications

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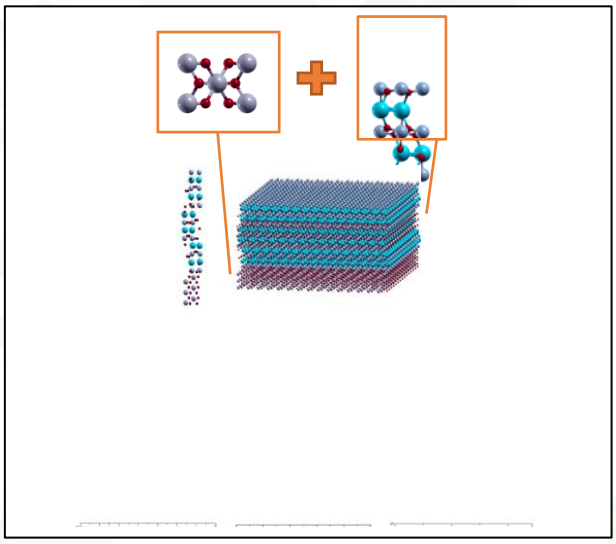

Perovskites, with their long list of interesting properties, have been in focus of large groups of scientists for over a decade. Together with that, the ability to easily swap cations inside the perovskite structure gives a vast variety of perovskites that can be investigated. In tandem with silicon, which is still primarily used as a material for solar cells, perovskites have been successfully used to achieve higher efficiency of solar cells compared to only silicon based solar cells.

Joining different materials in a heterostructure can enhance their desired properties, while at the same time it can help in dealing with individual shortcomings. Interface modelling can therefore be a crucial tool in new solar cell material design. Using density functional theory (DFT) can help in predicting properties at the interface. After solving quantum mechanical equations by using DFT, we can look into certain physical quantities that are of interest for predicting newly obtained interface properties.

Keywords: DFT, heterostructure, interface, perovskite, perovskite solar cells

Sinteza, strukturna karakterizacija i biološko djelovanje manoziliranih desmuramil-peptida

Synthesis, structural characterization and biological activity of mannosylated desmuramyl peptides

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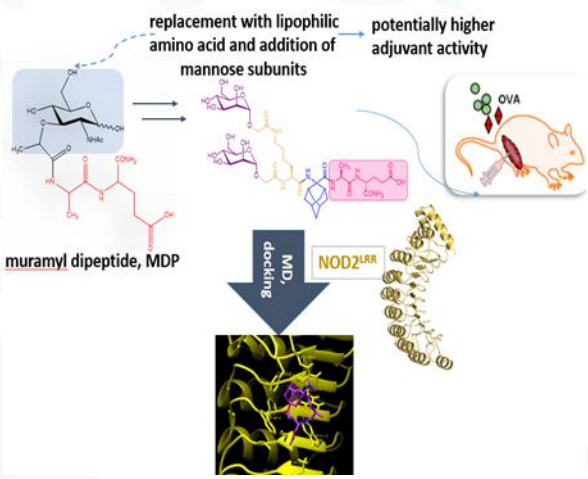

In the thesis the synthesis of new desmuramyl peptides with incorporated adamantane amino acids and their mannose peptide derivatives is described. Compounds are prepared in order to investigate their immunomodulatory properties and structural characteristics. Peptide and glycopeptide synthesis were optimized and obtained products were structurally characterized. The immunomodulatory activity of desmuramyl peptides with incorporated 2-aminoadamantane-2-carboxylic acid and mannose derivatives was examined *in vivo* using a mouse model. The effects of the synthesized compounds on adjuvant activity were determined based on the total amount of specific anti-OVA IgG antibodies and subclasses of IgG antibodies and compared with the activity of the known ManAdDMP adjuvant. Mannosylated derivatives showed enhanced immunostimulatory activity, while the dimannosylated derivative proved to be the most active adjuvant. In the thesis, a systematic conformational analysis of selected desmuramyl peptides in water and DMSO was performed using computational modelling and NMR spectroscopy. Docking and molecular dynamics simulations of mannosylated desmuramyl peptide complexes with intact NOD2 receptor, which has a central role in the modulation of the immune response, were also performed, and key amino acid residues involved in binding have been identified. Within the presented results, we also built intact structures of rabbit NOD2 protein, whose crystal structure lacks 7 loops, which play an important role in obtaining the optimal architecture of the binding pocket for establishing essential interactions with ligands.

Keywords: desmuramyl dipeptide, immunomodulatory activity, mannose, molecular dynamics simulations, NOD2 receptor

Priprava i biološka evaluacija novih hidroksipiridinonskih derivata
Preparation and biological evaluation of novel hydroxypiridinone derivatives

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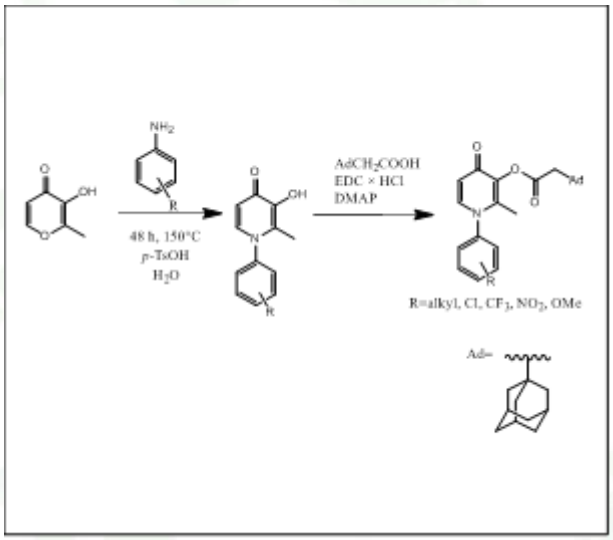

3-Hydroxypyridin-4-ones are a well known class of heterocyclic compounds extensively studied due to their broad spectrum of biological activities (antibacterial, antidiabetes, antiprotozoal, antineurodegenerative and anticancer). In our previous work we investigated several *para*-substituted *N*-aryl-3-hydroxy-2-methylpyridin-4-ones as well as their ester adamantyl derivatives for their *in vitro* antitumor properties. All tested compounds showed antiproliferative activity ranging from moderate to strong on all inspected cell lines with lipophilic adamantane containing derivatives being active at low micromolar IC_{50} concentrations. In the continuation of our work novel *meta*- and *para*- substituted *N*-aryl-3-hydroxy-2-methylpyridin-4-ones were prepared with the aim of evaluating their *in vitro* antitumor properties on five cancer cell lines as well as normal cell line. Novel derivatives are distinguished from compounds prepared in previous research by a) position of the substituent on the aryl part of the molecule (*meta*-position) and b) type of the substituent on the aryl part of the molecule (alkyl group). Reactions were conducted with heating of aqueous solutions of starting materials, maltol and *meta*- or *para*- substituted anilines, in autoclave. Prepared 3-hydroxypyridin-4-ones were additionally structurally modified by incorporating lipophilic units into pyridinone structure, primarily adamantyl unit, by Steglich esterification method. Structure of all prepared compunds were determined by ^{1}H NMR and $^{13}CNMR$ spectroscopy and/or MS/HRMS spectrometry. Antiproliferative activity of prepared compounds was examined and structure-activity relationship (SAR) was systematically researched in order to determine structural motifs responsible for their biological effect. On the basis of obtained results lead compounds were singled out whereby selective activity of compounds towards tumor versus normal cell lines was considered.

Keywords: adamantane, antiproliferative activity, 3-hydroxypyridin-4-ones, lipophilicity, structure-activity relationship study

Multifunkcionalni visokoentropijski oksidi
Multifunctional high-entropy oxides

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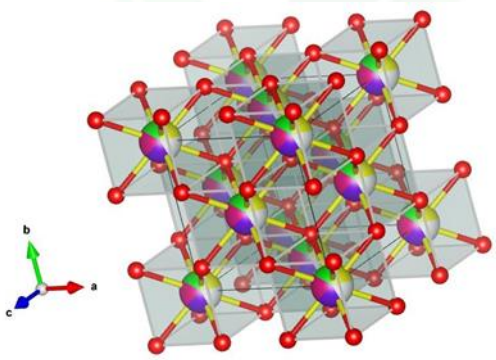

A new concept of materials design, rendering the possibility to affect the phase stability of solid solutions through precise control of configurational entropy, has evolved with the discovery of high entropy alloys. More recently, the field of high-entropy materials (HEMs) has been widened to include different groups of non-metallic compounds, like oxides. The general principles of choosing appropriate constituents for the formation of single-phase high entropy oxide, based on studies reported so far rely on enthalpy of mixing, ionic radii consideration, oxidation state of cations involved and cation coordination number. High entropy oxides offer a great versatility and further the possibility to tailor properties by exchanging single elements. What is known until nowadays is that high entropy oxides show many appealing features and capabilities that have significantly boosted their potential applications in catalysis, energy conversion and storage.

Keywords: ceria, heterogeneous catalysis, high entropy oxides, organic conversions, photocatalysis