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University of Belgrade
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OCTOBER 5-6 2018

PROGRAM

I

ZBORNIK RADOVA

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&

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Belgrade, Octobre 5-6, 2018

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3 plenarna predavanja (PP),
8 predavanja po pozivu (PPP)
3 sekcijska predavanja (SP)
228 saopštenja prihvaćenih za prezentovanje na konferenciji
od čega 66 usmenih označenih sa U/O

This book contains abstracts of
3 Plenary Lectures (PL)
8 Invited Lectures (IL)
3 Section Lectures (SL)
228 contributions accepted for the presentations at conference
of which 66 oral presentations designated by U/O

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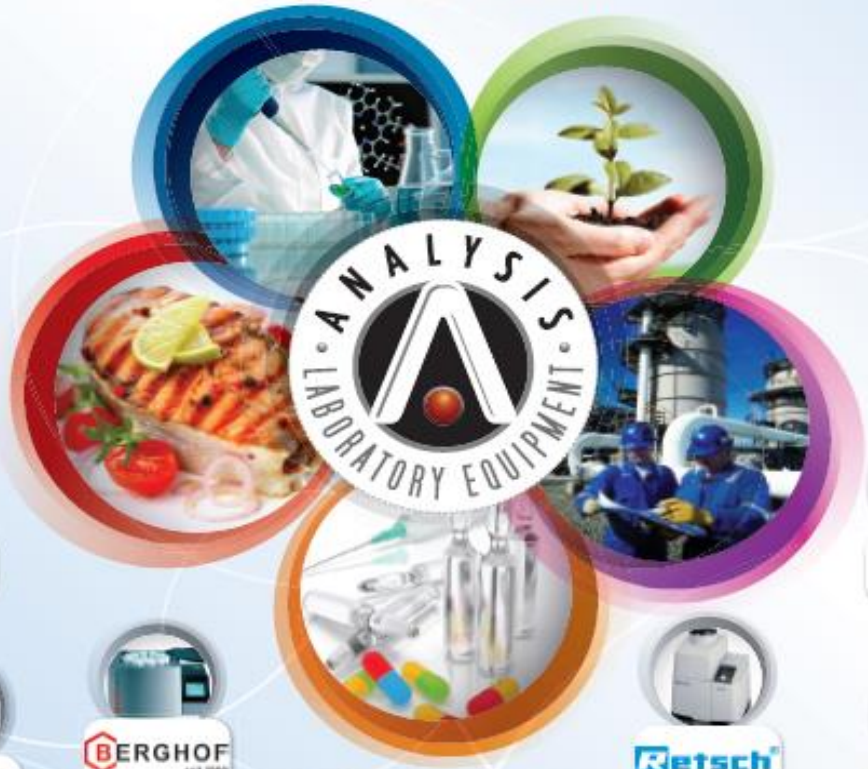

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Sadržaj

PLENARNA I PREDAVANJA PO POZIVU
Datum (Date): Petak (Friday), 5.10.2018.
Mesto (Place): Rektorat BU, svečana sala, Studentski trg 1, (Rectory building, Congress hall)

8.30-9.00	Registracija (Registration)	
9:00-9:30	Pozdravne reči i otvaranje Welcome speech and opening	**Prof. Dr. Ivanka Popović** Rektor/Rector **Prof. Dr. Vladimir Bumbaširević** Predhodni Rektor/ Previous Rector Predstavnici Ministarstva za obrazovanje, nauku i tehnološki razvoj RS/Representatives of the Ministry of Education, Science and Technological Development RS **Dr Marina Soković** predsednik naučnog odbora UNIFood konferencije/President of the Scientific Committee
9:30-12:50	Plenarna predavanja i predavanja po pozivu (Plenary and inviting lectures)	Moderatori/Moderators: **Prof. Dr Živoslav Tešić, Dr Marina Soković**
9:30-10:10	Suštinska uloga prirodnih resursa na putu otkrivanja novog bio-baziranog aditiva za hranu The essential role of natural resources on novel bio-based food additives discovery pathway *PLENEARNO PREDAVANJE* *PLENARY LECTURE*	**Prof. Dr. Isabel C.F.R. Ferreira** Politehnički institut Braganca i direktor Centra za istraživanje (CIMO), Braganca, Portugal. Direktor Mountain Research Centra (CIMO), Bragança, Portugalija Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
10:10-10:30	Nedigestibilne komponenate hrane i njihov značaj za stimulaciju simbiotske aktivnosti crevne mikrobiote	**Dr. Mirjana Rajilić-Stojanović** Tehnološko metalurški fakultet, Univerzitet u Beogradu, Srbija Department for Biochemical Engineering and Biotechnology,

	Indigestible food components and their role in promoting symbiotic activity of gut microbiota *Predavanje po pozivu* *Invited lecture*	Faculty of Technology and Metallurgy, University of Belgrade
10:30-10:50	Jestive i lekovite gljive - Uticaj na zdravlje ljudi Edible and medicinal mushrooms - The beneficial role for human health *Predavanje po pozivu* *Invited lecture*	**Dr. Ana Ćirić** Institutu za biološka istraživanja "Siniša Stanković", Univerzitet u Beogradu, Srbija Institute for Biological Research "Siniša Stanković", University of Belgrade, Belgrade, Serbia.
11:00-11:30	Kafe pauza (Coffee break)	
11:30-12:10	Mikrobiološka ekologija fermentisanih namirnica: Kako je razvoj tehnologije promenio način istraživanja raznovrsnosti The microbial ecology of fermented foods: how the technology development changed the way we investigate diversity *PLENEARNO PREDAVANJE* *PLENARY LECTURE*	**Prof. Dr. Luca Cocolin** Odeljenje za poljoprivredu, šumarstvo i nauku o hrani, Univerzitet u Torinu, Italija Department of Agricultural, Forest and Food Sciences, University of Torino, Italy
12:10-12:30	Masena spektrometrija kao fudomički alat za istraživanje i kontrolu proteinskih alergena hrane Mass spectrometry as foodomics tool in research and control of food allergen proteins *Predavanje po pozivu* *Invited lecture*	**Dr. Uroš Anđelković** Centar za hemiju - Institut za hemiju, tehnologiju i metalurgiju, Univerzitet u Beogradu, Srbija Institute of Chemistry, Technology and Metallurgy – University of Belgrade

12:30 – 12:50	Struktura i funkcija proteinskih kompleksa nastalih tokom obrade mleka Structure and function of milk protein complexes generating during milk processing *Predavanje po pozivu* *Invited lecture*	**Prof. Dr. Mirjana Pešić** Poljoprivredni fakultet, Univerzitet u Beogradu, Srbija Faculty of Agriculture, University of Belgrade, Belgrade, Serbia
13:00 – 15:00	**RUČAK (LUNCH)**	
15:00-15:50	Predavanja po pozivu (Invited lectures)	Moderatori/Moderators: **Prof. Dr Mirjana Pešić, Dr. Vuk Maksimović**
15:00 – 15:20	Primena naučnih istraživanja u razvoju koncepta funkcionalne hrane Application of scientific research in the development of the functional foods concept *Predavanje po pozivu* *Invited lecture*	**Dr. Bojana Vidović** Farmaceutski fakultet, Odeljenje za Bromatologiju, Univerzitet u Beogradu, Beograd, Srbija Faculty of Pharmacy, Department of Bromatology, University of Belgrade, Belgrade, Serbia
15:20-15:50	Vino i zdravlje Wine and health *Predavanje po pozivu* *Invited lecture*	**Dr. Jelica Grujić-Milanović** Institut za medicinska istraživanja, Univerzitet u Beogradu, Beograd, Srbija Institute for Medical Research, University of Belgrade, Belgrade, Serbia
16:00-18:00	**SEKCIJE (SECTIONS)**	
GALA VEČERA, 20h, dvorište Rektorata BU (GALA DINNER, 20h, garden of Rectory building)		

Datum (date): **Subota (Saturday), 6.10.2018.**

Mesto (Place): Rektorat BU, Svečana sala, Studentski trg 1, (Rectory building, Congress hall)

8:30-9:00	Registracija (Registration)	
9:00-10:20	Plenarna predavanja i predavanja po pozivu (Plenary and Invited lectures)	Moderatori/Moderators: **Prof. Dr. Bojana Vidović, Prof. Dr. Nikola Tomić**
9:00 - 9:40	OMICS pristupi u proceni rizika bezbedosti hrane: izloženost kombinacijama opasnosti i interakcije između patogena i domaćina OMICS approaches in food safety risk assessment: mixture exposure and host-pathogen interactions *PLENEARNO PREDAVANJE* *PLENARY LECTURE*	**Prof. Dr. Andreja Rajković** Odeljenje za tehnologiju i bezbednost hrane i zdravlja, Fakultet za biološke nauke i inžinjering, Gent, Belgija, Odeljenje za bezbednost i kvalitet hrane i menadžment, Univerzitetu Beogradu, Beograd, Srbija Department of Food technology, Food safety and Health, Faculty of Bioscience Engineering, Ghent; Department of Food Safety and Food Quality Management, University of Belgrade-Faculty of Agriculture, Serbia
9:40-10:00	Probiotička svojstva laktobacila proizvodjača egzopolisaharida i njihova primena u funkcionalnoj hrani Probiotic Applications of Exopolysaccharides-Producing Lactobacilli in Functional Food *Predavanje po pozivu* *Invited lecture*	**Dr. Milica Živković** Institut za molekularnu genetiku i genetičko inženjerstvo, Univerzitet u Beogradu, Srbija Laboratory for Molecular Microbiology, Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Belgrade, Serbia
10:00-10:20	Hemometrija u fudomici Chemometrics in foodomics *Predavanje po pozivu* *Invited lecture*	**Dr. Jelena Trifković** Hemisjki fakultet, Univerzitet u Beogradu, Srbija Faculty of Chemistry, University of Belgrade, Belgrade, Serbia
10:20-10:40	Kafe pauza (Coffee break)	

10:45-12:45	**SEKCIJE (SECTION)**	
12:45-14:30	**OKRUGLI STO (ROUND TABLE)**	Moderatori/Moderators: **Prof. Dr Viktor Nedović, M.Sci Ivanka Milenković**
	Nauka i znanje – alat u proizvodnji visokovredne hrane Science and knowledge – tools in the production of high quality food	**M. SCI. Ivanka Milenković,** Ekofungi, Beograd, Srbija Ecofungi, Beolgrade, Serbia
	Potsticanje preduzetničkog načina razmišljanja kod studenata – Ekotrofelija studentsko takmčenje Encouraging of entrepreneurial way of thinking in the student's population – EcoTrohelia student's competition	**Prof. Dr. Viktor Nedović**, Poljoprivredni fakultet, Univerzitet u Beogradu, Srbija Agricultural faculty, University of Belgrade, Belgrade, Serbia
	Nauka i privreda u Srbiji – mehanizmi stimulisanja saradnje Science and economy in Serbia – mechanisms for incentivizing cooperation	**Dr. Mlađan Stojanović** Fond za inovacionu delatnost, Beograd, Srbija Innovation fund, Belgrade, Serbia
	Evropska Agencija za bezbednost hrane/EFSA European Food Safety Agency/EFSA	**Nadežda Dukić** Uprava za veterinu, Ministarstvo poljoprivrede, šumarstva i vodoprivrede Veterinary Directorate, Ministry of Agriculture, Forestry and Water Management
	Inicijativa Globalne Harmonizacije (GHI) Global Harmonization Initiative (GHI)	**Prof. Dr. Mirjana Pešić** Poljoprivredni fakultet Univerzitet u Beogradu, Beograd, Srbija Agricultural faculty, University of Belgrade, Belgrade, Serbia
14:00-14:15	Zaključci konferencija i zatvaranje (Conclusions and closing ceremony)	**Dr. Marina Soković** predsednik naučnog odbora UNIFood konferencije (President of the Scientific Committee)
14:15-15:15	RUČAK (LUNCH)	

USMENE PREZENTACIJE SEKCIJSKA PREDAVANJA

Datum (Date): **Petak (Friday), 5.10.2018.**

Mesto (Place): **Rektorat BU, Studentski trg, 1 Rectory building, Hall I floor**

16-18h Sala 8 (Hall 8)	**SEKCIJA (SECTION): FOOD AND HEALTH**	Moderatori: Prof. Dr Ljiljana Gojković-Bukarica, Prof. Dr Jelena Lozo Moderators: Prof. Dr Ljiljana Gojković-Bukarica, Prof. Dr Jelena Lozo
16:00-16:15	Razvoj prirodne boje za hranu zasnovane na antocijaninima dobijenim iz epikarpa *Prunus spinosa* L. Development of a natural anthocyanin-based food colorant obtained from the fruit epicarp of *Prunus spinosa* L. ***Sekcijsko predavanje (Sectional Lecture)***	**Barros (Leichtweis et al)** Politehnički institut Braganca i direktor Centra za istraživanje (CIMO), Braganca, Portugal. Direktor Mountain Research Centra (CIMO), Bragança, Portugalija Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Bragança, Portugal
16:15-16:25	Polifenol vina, rezveratrol širi renalnu arteriju dijabetičnog pacova aktivacijom vaskularnih kalijumovih kanala Wine polyphenol, resveratrol produses relaxation of isolated renal artery of diabetic rats by activation of vascular potassium channels	**Gojković-Bukarica et al.** Institut za farmakologiju, kliničku farmakologiju i toksikologiju, Medicinski fakultet, Univerzitet Beograd Institute of Pharmacology, Clinical Pharmacology and Toxicology, Medical Faculty, University of Belgrade, Belgrade, Serbia
16:25-16:35	Dijetarni antocijani i njihovi metaboliti snižavaju adheziju i dijapedezu monocita preko mehanizama koji regulišu permeabilnost endotelnih ćelija Dietary anthocyanins and their metabolites lower monocyte adhesion and diapedesis through mechanisms that regulate endothelial cell permeability	**Krga et al.** Centar izuzetne vrednosti u oblasti istraživanja ishrane i metabolizma, Institut za Medicinska Istraživanja, Univerzitet u Beogradu, Beograd, Srbija; Francuski nacionalni institut za agronomska istraživanja, Univerzitet Klermon Overnja, Klermon Feran, Francuska;

		Centre of Research Excellence in Nutrition and Metabolism, Institute for Medical Research, University of Belgrade, Belgrade, Serbia; French National Institute for Agricultural Research, University of Clermont Auvergne, Clermont-Ferrand, France;
16:35-16:45	Uklanjanje alkohola crvenom vinu čini ga korisnim napitkom za obolele od hipertenzije Dealcoholized red wine as a useful beverage of hypertensive subjects	**Mihailović-Stanojević et al.** Grupa za kardiovaskularnu fiziologiju, Instituta za medicinska istraživanja, Univerziteta u Beogradu, Beograd, Srbija. University of Belgrade, Institute for Medical Research, Belgrade, Serbia.
16:45-16:55	Prirodni polifenoli, rezveratrol i naringenin, inhibiraju patološke kontrakcije miometrijuma Natural polyphenols, rezveratrol and naringenin, inhibit pathological contractions of the myometrium	**Novaković et al.** Institut za farmakologiju, kliničku farmakologiju i toksikologiju, Medicinski fakultet, Univerzitet u Beogradu, Beograd, Srbija. Institute of Clinical Pharmacology, Pharmacology and Toxicology, Medical Faculty, University of Belgrade, Belgrade, Serbia.
16:55-17:05	Kardioprotektivni efekat dijetarnih procijanidina Cardioprotective effect of dietary procyanidins	**Marinko et al.** Katedra za farmakologiju, Farmaceutski fakultet, Univerzitet u Beogradu, Beograd, Srbija Department of Pharmacology, Faculty of Pharmacy, University of Belgrade, Belgrade, Serbia
17:05-17:15	Dohrana ekstraktom lista masline, *Olea europaea* L., poboljšava oksidativni status i lipidni profil u eksperimentalnoj hroničnoj bubrežnoj bolesti Consumption of *Olea europaea* L. leaf extract improves oxidative status and lipid profile in experimental chronic kidney disease	**Karanović et al.** Institut za medicinska istraživanja, Univerzitet u Beogradu, Srbija Institute for Medical Research, University of Belgrade, Serbia

17:15-17:25	Povezanost otpora u karotidnoj arteriji i endogene antioksidativne odbrane sa arterijskim pritiskom nakon unosa majkine dušice, u hipertenziji i normotenziji. Correlation of resistance in the carotid atrery and endogenous antioxidant defence with arterial pressure in responce to wild thyme: hypertension versus normotension	**Miloradović et al.** Univerzitet u Beogradu, Institut za medicinska istraživanja, Grupa za kardiovaskularnu fiziologiju,Beograd, Srbija. University of Belgrade, Institute for Medical Research, Group for Cardiovascular Physiology, Belgrade, Serbia.
17:25-17:35	Efekat ekstrakta lista masline (*Olea europaea* L.) u odnosu na oleuropein u eksperimentalnoj hipertenziji Effects of *Olea europaea* L. leaf extract versus oleuropein in experimental hypertension	**Ivanov et al.** Grupa za kardiovaskularnu fiziologiju, Instituta za medicinska istraživanja, Univerziteta u Beogradu, Beograd, Srbija. Department of Cardiovascular Physiology, Institute for Medical Research, University of Belgrade, Belgrade, Serbia.
17:35-17:45	Efekti primene *Lactobacillus rhamnosus* LA68 na sastav masnih kiselina organa u uslovima standardne i ishrane sa visokim sadržajem masti - studija na životinjama Effects of *Lactobacillus rhamnosus* LA68 administration on the fatty acid composition of the organs in the conditions of standard and high fat diet regime–animal case study	**Ivanović et al.** Katedra za bromatologiju, Univerzitet u Beogradu – Farmaceutski fakultet Department of Bromatology, Faculty of Pharmacy, University of Belgrade, Belgrade, Serbia.
17:45-17:55	Mehanizam vazorelaksacije humane unutrašnje mamilarne arterije izazvane epikatehinom Mechanism underlying the vasorelaxation of human internal mammary artery induced by epicatechin	**Novakovic A et al.** Katedra za farmakologiju, Farmaceutski fakultet, Univerzitet u Beogradu, Beograd, Srbija Department of Pharmacology, Faculty of Pharmacy, University of Belgrade, Belgrade, Serbia

16-18h Svečana sala (Congress Hall)	**SEKCIJA (SECTION): FOOD SAFETY AND QUALITY**	Moderatori: Prof. Dr Jevrosima Stevanovic, Prof. Dr Dušanka Milojković-Opsenica Moderators: Dr Jevrosima Stevanovic, Prof. Dr Dušanka Milojković-Opsenica
16:00-16:15	Minimalizam u analizi hrane, ali maksimalni priliv informacija Minimalism in food analysis, but maximal information ***Sekcijsko predavanje (Sectional Lecture)***	**Gertruda Morlock** Rukovodilac odeljenja za Ispitivanje hrane, Justus Leipcig Univerzitet, Nemačka Chair of Food Sciences, Justus Liebig University Giessen, Germany
16:15-16:25	3D planarna hromatografija zasnovana na autmotizovanoj head HPTLC-MS Open source 3D printed add-on for automated elution head-based HPTLC-MS	**Häbe and Morlock** Rukovodilac odeljenja za Ispitivanje hrane, Justus Leipcig Univerzitet, Nemačka Chair of Food Sciences, Justus Liebig University Giessen, Germany
16:25-16:35	Optimizacija uslova ekstrakcije fenolnih jedinjenja izolovanih iz cvetova kestena Optimization of the extraction of phenolic compounds from chestnut tree flowers	**Prieto (Caleja et al)** Fakultet za ispitivanje I tehnologiju hrane, Univerzitet u Vigu, Španija Nutrition and Bromatology Group, Faculty of Food Science and Technology, University of Vigo, Ourense, Spain
16:35-16:45	Hemijska analiza i evaluacija biološkog porekla meda sa Malte Chemical analysis and evaluation of botanical origin of some Maltese honey	**Tosti et al.** Hemijski fakultet, Univerzitet u Beogardu, Srbija Faculty of Chemistry, University of Belgrade, Serbia
16:45-16:55	Polifenolni i šećerni profil meda od heljde Polyphenol and sugar profile of buckwheat honey	**Nešović et al.** Institut za opštu i fizičku hemiju, Beograd, Srbija Institute of general and physical chemistry, Belgrade, Serbia

16:55-17:05	Hemijska analiza i analiza botaničkog porekla medova iz Albanije Chemical analysis and evaluation of botanical origin of some Albanian honeys	**Hoxha et al.** Poljoprivredni Univerzitet u Tirani, Fakultet za biotehnologiju i hranu, Albanija Agricultural University of Tirana, Faculty of Biotechnology and Food, Albania
17:05-17:15	Eksploitacija antocijanina iz eksrakta *Ficus carica* L.: optimizacija ekstrakcije, bioaktivnost i primena kao boje za životne namirnice *Ficus carica* L. infructescence exploitation for anthocyanin-rich extracts preparation: optimized extraction, bioactivity, and application as food colorant	**Perreira Carla** Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Bragança, Portugal Laboratory of Separation and Reaction Engineering – Laboratory of Catalysis and Materials (LSRE-LCM), Polytechnic Institute of Bragança, Bragança, Portugal
17:15-17:25	Biološko profilisanje ekstrakata *Saccharina japonica* primenom planane hromatografije povezane sa biološkim esejima Bioprofiling of *Saccharina japonica* extracts by planar chromatography linked with bioassays	**Ristivojevic et al.** Inovacioni centar Hemijskog fakulteta u Beogradu, Studentski trg 12-16, Beograd, Srbija Inovation Centre of the Faculty of Chemistry Ltd, Studentski trg 12-16, 11000 Belgrade, Serbia
17:25-17:35	Funkcionalizacija ekstrakata *Agaricus bisporus* u jogurtu putem mikroenkapsulacije primenom “spray-drying” tehnike Functionalization of yogurts with *Agaricus bisporus* extracts microencapsulated through the spray-drying technique	**Heleno et al.** Politehnički institut Braganca i direktor Centra za istraživanje (CIMO), Braganca, Portugal. Direktor Mountain Research Centra (CIMO), Bragança, Portugalija Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal

17:35-17:45	Sadržaj fenolnih jedinjenja i antioksidativna aktivnost dve vrste roda *Asplenium* u različitim fazama životnog ciklusa Phenolics content and antioxidant activity of two *Asplenium* species: life cycle-specific patterns	**Zivkovic et al.** Institut za biološka istraživanja "Siniša Stanković", Univerzitet u Beogradu, Beograd, Srbija Institute for Biological Research „Sinisa Stankovic", University of Belgrade, Belgrade, Serbia
17:45-17:55	Izbor metode za određivanje sadržaja dijetetskih suplemenata Method analysis choice for content determination of dietary supplements	**Jelić et al.** Univerzitet u Banjoj Luci, Medincinski fakultet, Farmacija, Banjaluka, Bosna i Hercegovina University of Banjaluka, Faculty of Medicine, Pharmacy Department, Banjaluka, Bosnia and Herzegovina
17:55-18:05	Sadržaj NaCl u mekim sirevima - aspekt bezbednost i zdravlje ljudi Sodium chloride content in soft cheeses with respect to food safety and public health	**Radovanovic et al.** Fakultet veterinarske medicine, Univerzitet u Beogradu, Srbija Faculty of Veterinary Medicine, University of Belgrade, Serbia

16-18h Sala 16 (Hall 16)	**SEKCIJA (SECTION): FOOD CHAIN SUSTAINABILITY**	Moderatori: Prof. Dr Milica Fotirić-Akšić, Prof. Dr Slavica Todić Moderators: Prof. Dr Milica Fotirić-Akšić, Prof. Dr Slavica Todić
16:00-16:15	Efekat istraživanja na proizvodnju trešnje u severnom klimatu Impacts of research on sweet cherry production in a northern climate ***Sekcijsko predavanje (Sectional Lecture)***	**Meland and Fotirić-Akšić** Norveški insitut za Bioekonomiju, NIBIO Ullensvang, Norveška Norwegian Institute of Bioeconomy Research – NIBIO Ullensvang, Norway

16:15-16:25	Hemijska svojstva ploda sorti borovnice (*Vaccinium corymbosum*) gajenih u integralnoj i organskoj proizvodnji Chemical characterisation of blueberry (*Vaccinium corymbosum*) fruit obtained from integral and organic production	**Fotrić-Akšić et al.** Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija University of Belgrade, Faculty of Agriculture, Belgrade, Serbia
16:25-16:35	Hemijski sastav biomase prosa i soje gajenih u sistemu kombinovanih useva Chemical composition of biomass of proso millet and soybean grown in intercropping system	**Milenković et al.** Institut za kukuruz „Zemun Polje“,Zemun Polje, Srbija; Maize Research Institute „Zemun Polje“, Zemun Polje, Serbia;
16:35-16:45	Elementalni sastav: studija klonske selekcije sorte Merlo Elemental composition: the case study of Merlot clonal selection	**Pejin et al.** Univerzitet u Beogradu, IMSI, Beograd, Srbija University of Belgrade, IMSI, Belgrade, Serbia
16:45-16:55	Upotreba ulja *Origanum dictamnus* u prevenciji dejstva protiv *Botrytis cinerea* Exploitation of *Origanum dictamnus* oil for the preservation of fresh produce against *Botrytis cinerea*	**Tzortzakis (Stavropoulou et al)** Odeljenje za Poljoprivredne nauke, Biotehnologiju i ishranu, Univerzitet za tehnologiju Limassol, Kipar Department of Agricultural Sciences, Biotechnology; Food Science, Cyprus University of Technology, Limassol, Cyprus.
16:55-17:05	Dizajniranje inovativnih funkcionalnih starter kultura za proizvodnju mlečnih fermentisanih proizvoda Designing of innovative functional starter cultures for production of added-value dairy products	**Kljajevic et al.** „Invetlab“ doo, Institut za molekularnu genetiku i genetičko inženjerstvo, Univerzitet u Beogradu „Invetlab“ doo, 2 Institute of molecular genetics and genetic engineering, University of Belgrade

17:05-17:15	Senzorska svojstva kvaliteta pralina punjenih medom sa dodatkom voća i lekovitog bilja Sensory properties of pralines with honey filling and addition of fruits and medicinal herbs	**Popov-Raljić et al.** Prirodno-matematički fakultet, Univerzitet u Novom Sadu Faculty of Science, University of Novi Sad
17:15-17:25	Ekstrakcija ruzmarinske kiseline iz tri medicnske I aromatične biljke uz pomoć povišene temperature primenom metode površinskog odgovora Using response surface methodology to maximize heat assisted extraction of rosmarinic acid in three medicinal and aromatic plants	**Carocho et al.** Politehnički institut Braganca i direktor Centra za istraživanje (CIMO), Braganca, Portugal. Direktor Mountain Research Centra (CIMO), Bragança, Portugalija Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
17:25-17:35	Karakterizacija tofua pripremljenog sa dodatkom inulina Characterization of tofu prepared with the addition of inulin	**Stanojević et al.** Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija University of Belgrade, Faculty of Agriculture, Belgrade, Serbia
17:35-17:45	Uticaj različitih metoda sušenja na senzorna svojstva cvekle Effects of different drying methods on changes in sensory properties of beetroot	**Tomić et al.** Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija University of Belgrade, Faculty of Agriculture, Belgrade, Serbia
17:45-17:55	Precizan farmski uzgoj u kontekstu bezbednosti hrane Precision livestock farming in a food safety context	**Nastasijević et al.** Institut za higijenu i tehnologiju mesa, Beograd, Srbija Institute for hygiene and meat technology, Belgrade, Serbia

17:55-18:05	Uticaj različitih sistema mineralne ishrane na antioksidativni kapacitet zrna kukuruza The impact of different mineral nutrition on antioxidative capacity of maize grain	**Dragičević et al.** Institut za kukuruz „Zemun Polje“, Srbija Maize Research Institute Zemun Polje, Serbia

Datum (Date): Subota (Saturday), 6.10.2018.

Mesto (Place): Rektorat BU, Studentski trg 1, Rectory building Hall I floor

10:45-12:45 Svečana sala (Congress Hall)	**SEKCIJA (SECTION): FOOD QUALITY AND SAFETY**	Moderatori/Moderators: Dr Uroš Anđelković, Prof. Dr Dragana Stanić-Vučinić
10:45-10:55	Samonikla jestiva makromiceta *Pleurotus ostreatus* (Jacq.)P. Kumm sa teritorije Srbije: potencijalni kandidat za funkcionalnu hranu Wild growing edible mushroom *Pleurotus ostreatus* (Jacq.)P. Kumm from Serbia: a potential candidate for functional food	**Petrović et al.** Institut za biološka istraživanja „Siniša Stanković“, Univerzitet u Beogradu, Beograd, Srbija Institute for Biological Research „Sinisa Stankovic“, University of Belgrade, Belgrade, Serbia
10:55-11:05	Bioaktivna jedinjenja iz jestive gljive *Laetiporus sulphureus* (Bull.) Murrill. Antioksidativne, antifungalne I antibakterijske karakteristike. Bioactive compounds of the wild edible mushroom *Laetiporus sulphureus* (Bull.) Murrill. Antioxidant, antifungal and antibacterial properties	**Proestos (Petrovic et al)** Laboratorija za hemiju hrane, Odeljenje za hemiju, Univerzitet u Atini, Grčka Laboratory of Food Chemistry, Department of Chemistry, National and Kapodistrian, University of Athens, Greece
11:05-11:15	Antimikrobna svojstva ekstrakata Čage (*Inonotus obliquus*) Antimicrobial properties of Chaga extracts (*Inonotus obliquus*)	**Popović et al.** Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija University of Belgrade, Faculty of Agriculture, Belgrade, Serbia

11:15-11:25	*Amaranthus caudatus* L. izvor betacijanina sa antimikrobnim I potencijalom za bojenje *Amaranthus caudatus* L. as a source of betacyanins with coloring and antimicrobial properties	**Roriz et al.** Politehnički institut Braganca i direktor Centra za istraživanje (CIMO), Braganca, Portugal. Direktor Mountain Research Centra (CIMO), Bragança, Portugalija Nutricija I Bromatologija, Fakultet za farmaciju, Univerzitet u Madridu, Španija Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Bragança, Portugal Nutrición y Bromatología II. Facultad de Farmacia. Universidad Complutense de Madrid (UCM), Madrid, Spain.
11:25-11:35	Alternativni izvor n-3 masnih kiselina poreklom iz biljaka Alternative sources of n-3 fatty acids from plant origin	**Petropoulos et al.** Univerzitet u Tesalonikiju, Odeljenje za poljoprivredu, useve i ruralnu sredinu, Volos, Grčka University of Thessaly, Department of Agricultur, Crop Production and Rural Environment, Volos Greece
11:35-11:45	Masno-kiselinski sastav ulja semenki internacionalnih i autohtonih sorti grožđa Fatty acid composition of lipids of international and autochthonous grape seed varieties	**Milinčić et al.** Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija University of Belgrade, Faculty of Agriculture, Belgrade, Serbia
11:45-11:55	Hemijski sastav karotenoida i tokola u masnom ulju iz semena autohtone sorte grožđa - tamjanike (*Vitis vinifera* L.) i njegova antimikrobna aktivnost Chemical composition of carotenoids and tocols in fatty oil from the seeds of autochtonus grape variety - tamjanika (*Vitis vinifera* L.) and its antimicrobial activity	**Stojković et al.** Institut za biološka istraživanja „Siniša Stanković“, Univerzitet u Beogradu, Beograd, Srbija Institute for Biological Research „Sinisa Stankovic“, University of Belgrade, Belgrade, Serbia

11:55-12:05	Zlatno seme Kvinoje (*Chenopodium quinoa*): Nutritivne osobine i lekoviti efekti Golden Grain of Quinoa (*Chenopodium quinoa*): Nutritional characteristics and Health effects	**Stikić et al.** Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija University of Belgrade, Faculty of Agriculture, Belgrade, Serbia
12:05-12:15	Ruj-magično drvo Ruj – magic tree	**Novaković et al.** Institut za hemiju, tehnologiju i metalurgiju, Univerzitet u Beogradu Institute for Chemistry, Technology and Mettallurgy, University of Belgrade
12:15-12:25	Cvetni polen i polen medonosnih pčela kao potencijalni dodatak hrani - sadašnjost i perspektiva Floral pollen and bee pollen as potential food supplement-present and perspectives	**Kostić et al.** Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija
12:25-12:35	Faktori hazarda u proizvodnji bezbedne hrane za životinje i ljude Hazards in production of safe feed and food	**Perić (Šefer et al.)** Fakultet veterinarske medicine, Univerzitet u Beogradu, Beograd, Srbija Faculty of Veterinary Medicine, University of Belgrade, Belgrade, Serbia

10:45-12:45, Sala 8 (Hall 8)	**SEKCIJA (SECTION): FOOD AND HEALTH**	Moderatori/Moderators: Dr Nevena Mihailović-Stanojević, Dr Nataša Golić
10:45-10:55	Predloženi mehanizam uticaja oligosaharida dobijenih iz pektina na Intestinalnu mikrobiotu Possible mechanism of pectin-derived oligosaccharides influence on gut microbiota	**Miletić et al.** Univerzitet u Beogradu Institut za hemiju, tehnologiju i metalurgiju, Beograd, Srbija University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Belgrade, Serbia

10:55-11:05	Fenomen ukrštenih alergijskih obrazaca između alergena polena *Phleum pratense* i žitarica Phenomenon of cross reactivity patterns between allergens of *Phleum pratense* pollen and cereals	**Fočak and Solaković-Fočak** Odsek za biologiju, Prirodno-matematički fakultet, Univerzitet u Sarajevu Department of Biology, Faculty of Science, University of Sarajevo
11:05-11:15	Leptinska i insulinska osetljivost u hipotalamusu mužjaka pacova izloženih kombinovanom tretmanu ishranom bogatom fruktozom i hroničnim nepredvidivim stresom. Leptin and insulin sensitivity in the hypothalami of rats subjected to fructose-enriched diet combined with chronic unpredictable stress	**Nikolić (Bursać et al.)** Odeljenje za biohemiju, Institut za biološka istraživanja „Siniša Stanković“, Univerzitet u Beogradu, Beograd, Srbija Department of Biochemistry, Institute for Biological Research „Sinisa Stankovic“, University of Belgrade, Belgrade, Serbia
11:15-11:25	Efekti restrikcije hrane u 5XFAD mišijem modelu Alchajmerove bolesti Limited Effects of Intermittent Fasting in 5xfad Mouse Model of Alzheimer's Disease	**Perović et al.** Institut za biološka istraživanja „Siniša Stanković“, Univerzitet u Beogradu, Beograd, Srbija Institute for Biological Research „Sinisa Stankovic“, University of Belgrade, Belgrade, Serbia
11:25-11:35	Probiotički soj *Lactobacillus brevis* BGZLS10-17 ublažava simptome eksperimentalnog autoimunskog encefalomijelitisa kod DA pacova Administration of *Lactobacillus brevis* BGZLS10-17 alleviates symptoms of experimental autoimmune encephalomyelitis in DA rats.	**Soković-Bajić et al.** Laboratorja za molekularnu mikrobiologiju, Institut za molekularnu genetiku i genetičko inženjerstvo, Univerzitet u Beogradu, Beograd, Srbija Laboratory for Molecular Microbiology, Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Belgrade, Serbia

11:35-11:45	Zoonotske protozoe svinja prenošene hranom – ima li efikasne prevencije? Foodborne zoonotic protozoa transmitted by pigs – too much on our plate?	**Klun et al.** Centar izuzetnih vrednosti za zoonoze prenošene hranom i vektorima, Institut za medicinska istraživanja Univerziteta u Beogradu Centre of Excellence for Food- and Vector-borne Zoonoses, Institute for Medical Research, University of Belgrade
11:45-11:55	Razvoj tehnološkog postupka za proizvodnju inovativnog fermentisanog probiotika za prevenciju i tretman crevnih infekcija kod životinja Development of technological process for scale-up production of innovative fermented probiotic for prevention and treatment of intestinal infections in animals	**Babić et al.** „Invetlab“ doo, 2 Institut za molekularnu genetiku i genetičko inženjerstvo, Univerzitet u Beogradu „Invetlab“ doo, 2 Institute of molecular genetics and genetic engineering, University of Belgrade
11:55-12:05	Navike i stavovi omladine o regularnom unosu obroka i afinitetu prema određenim namirnicama Young population habits and attitudes towards meals intake regularity and food preference	**Popović et al.** Univerzitet u Novom Sadu, Tehnološki fakultet, Novi Sad, Srbija University of Novi Sad, Faculty of Technology, Novi Sad, Serbia
12:05-12:15	Veza stanja uhranjenosti dece i navika u ishrani Correlation of nutritional status and eating habits in children	**Đermanović et al.** Institut za javno zdravstvo Republike Srpske, Banja Luka, Bosna i Hercegovina Medicinski fakultet - Studijski program Farmacija, Univerzitet u Banjoj Luci, Bosna i Hercegovina Public Health Institute of Republic of Srpska, Banja Luka, Bosnia and Herzegovina Medical Faculty, Department for Pharmacy, University of Banja Luka, Bosnia and Herzegovina

12:15-12:25	Zdrava ishrana za zdrav život Healthy food for healthy life	**Ćurčić (Durgo et al.)** Univerzitet u Beogradu, Farmaceutski fakultet, Univerzitet u Beogradu, Beograd, Srbija University of Belgrade, Faculty of Pharmacy, Belgrade, Serbia
10:45-12:45 Sala 16 (Hall 16)	**SEKCIJA (SECTION): FOOD CHAIN SUSTAINABILITY**	Moderatori/Moderators: Dr Danijela Mišić, Prof. Dr Ljiljana Mojović
10:45-10:55	Transport lakokvarljive robe – ATP sporazum Transport of perishable foodstufs – ATP agreement	**Jovanović et al.** Univerzitet u Beogradu, Mašinski fakultet University of Belgrade, Faculty of Mechanical Engineering
10:55-11:05	Agro-industrijski otpad za proizvodnju mlečne kiseline i hrane za životinje Agro-industrial waste for production of lactic acid and animal feed	**Mladenović et al.** Tehnološko-metalurški fakultet, Univerzitet u Beogradu, Beograd, Srbija Faculty of Technology and Metallurgy, University of Belgrade, Serbia
11:05-11:15	MULTIPAPRIK – Inovativni uređaj za pečenje paprika MULTIPAPRIK – An innovative device for pepper processing	**Zloh et al.** Agricutural Innovations and Developement-Boljevci Agro Innovations and Developement-Boljevci
11:15-11:25	Strategije socijalnog marketinga u povećanju svesti o važnosti zdrave ishrane kod potrošača Social marketing strategies in the increasing of awareness about importance of consumers healthy nutrition	**Šarčević and Janičić** Institut za higijenu i tehnologiju mesa Institute of Meat Hygiene and Technology

11:25-11:35	Bezbednost hrane poreklom iz Srbije Safety issues in food originating from Serbia	**Torović** Medicinski fakultet, Univerzitet u Novom Sadu; Institut za javno zdravlje Vojvodine, Novi Sad, Srbija Faculty of Medicine, University of Novi Sad; Institute of public health of Vojvodina, Novi Sad, Serbia
11:35-11:45	Promocija proizvodnje i konzumiranja zdrave hrane kroz proces edukacije Promoting healthy food production and consumption through the educational process	**Mitrović et al.** Univerzitet u Beogradu, Arhitektonski fakultet University of Belgrade, Faculty of Architecture
11:45-11:55	Problemi poljoprivrede i sela Republike Srbije Problems of agriculture and the villages in the Republic of Serbia	**Pejanović** Univerzitet u Novom Sadu, Poljoprivredni fakultet University of Novi Sad, Faculty of Agriculture
11:55-12:05	Jačanje kulturnog identiteta Smedereva podsticanjem održivog gastroturizma u ruralnim zajednicama Strengthening cultural identity of the city of Smederevo by sustainable gastroturism in rural communities	**Radosavljević et al.** Univerzitet u Beogradu Arhitektonski Fakultet University of Belgrade Faculty of Architecture
12:05-12:15	Uloga i značaj hrane u bogosluženju Pravoslavne Crkve: liturgijski, bogoslovski i ekološki aspekti Role and significance of food in the worship of the Orthodox Church: Liturgical, theological and ecological aspects	**Ubiparipović** Pravoslavni bogoslovski fakultet Univerziteta u Beogradu Faculty of Orthodox Theology of the University of Belgrade

12:15-12:25	Etika ishrane od Manua do Srejovića Ethics of nutrition from Manu to Srejović	**Petrović and Petrović** Filološki fakultet Univerziteta u Beogradu, Srpsko društvo za istoriju nauke Faculty of Philology University of Belgrade, Serbian Society of History of Science
12:25-12:35	Simulacija upravljanja otpadom nakon obrade hrane u cilju zaštite životne sredine I bioenergije Simulation of the food processing waste treatment for cleaner environment and bioenergy	**Maljoljari et al.** Faculty of natural sciences, University of Tirana, Albania

POSTERSKE SEKCIJE / POSTERS SECTIONS

SEKCIJA (SECTION): FOOD QUALITY AND SAFETY

DATUM (DATE): Petak (Friday) 9-13h

Mesto (Place): **Rektorat BU, hol I sprat, Studentski trg 1 (Rectory building BU, Hall I Flat)**

1	Alimpić Aradski et al.	**Sinergistički antioksidativni efekti sastojaka pice** **Synergistic Antioxidant Effects of Pizza Ingredients**
2	Andrić F. et al.	**Antioksidativni kapacitet ekstrakata zelenog i crnog čaja – hemometrijski iskoraci u selekciji antioksidativnih testova i multipotentnih herbalnih ekstrakata** **Antioxidant capacity of green and black tea extracts – Chemometric advancements in selection of antioxidant activity assays and multipotent herbal extracts**
3	Andrić S. et at.	**Phenolic profile, antioxidative, and antimicrobial activity of Serbian linden tea** **Fenolni profil, antioksidativna i antimikrobna aktivnost srpskog čaja od lipe**
4	Atanacković Krstonošić et al.	**Četvorogodišne odležavanje poboljšava fenolni sastav crvenih vina iz Vojvodine** **Four years of aging improves phenolic composition of red wines from Vojvodina**
5	Bartolić et al.	**Fluorescentna spektroskopija i multivarijaciona analiza za procenu stabilnosti brašna od različitih žitarica tokom stajanja i termalne obrade** **Fluorescence spectroscopy and Multivariate Analysis for the assessment of stability of the cereal flours during storage and thermal processing**
6	Bilić Rajs et al.	**Primjena omjera stabilnih izotopa ugljika ($^{13}C/^{12}C$) u ocjeni autentičnosti bagremovog meda *(Robinia pseudoacacia* L.*)*** **Application of Stable Carbon Isotope Ratio ($^{13}C/^{12}C$) in the assessment of black locust (*Robinia pseudoacacia* L.) honey authenticity**
7	Bogavac et al.	**Antimikrobna i toksična svojstva esencijalnih ulja *Bosvellia serrata* Rokb. i *Mentha piperita* Linn.** **Antimicrobial and toxic properties of essential oils of *Boswellia serrata* Roxb. and *Mentha piperita* Linn.**
8	Bojanić et al	**Mikrobiološki kvalitet namirnica u Republici Srpskoj u 2016. godini** **Microbiological food quality in the Republic of Srpska in 2016**

9	Bošković et al.	**Bakterije mlečne kiseline u mlevenom mesu svinja kontaminiranom *Salmonella* spp sa dodatkom etarskog ulja origana pakovanom u vakuum i modifikovanu atmosferu** **LAB in minced pork contaminated with *Salmonella* spp treated with oregano essential oil packaged in vacuum and MAP**
10	Božović et al.	**Određivanje sadržaja arsena u vodama izvorišta i vodovodne mreže na teritoriji opštine Pančevo** **Determination of arsenic content in water sources and water supply network in the municipality of Pancevo**
11	Bulatović et al.	**Antimikrobna aktivnost biotehnološki modifikovanih proteina surutke** **Antimicrobial activity of biotechnologically modified whey proteins**
12	Čakar et al.	**Vino od borovnice – dobar prirodni izvor fenolnih kiselina** **Blueberry wine – a good natural source of phenolic acids**
13	Čakar et al.	**Uticaj mikrovinifikacije na anti α-glukozidaznu aktivnost vina od maline** **The impact of microvinification on anti α-glucosidase activity of raspberry wine**
14	Ćilerdžić et al.	**Sinergistička antineurodegenerativna aktivnost ekstrakata *Ganoderma lucidum* i *Salvia officinalis*** **Synergistic antineurodegenerative effect of *Ganoderma lucidum* and *Salvia officinalis* extracts**
15	Ćirić J. et al.	**Bioakumulacija arsena i pojedinih teških metala u tkivima puževa poreklom iz Srbije** **Bioaccumulation of arsenic and heavy metals in snail tissues from the Serbia**
16	Čolić S. Et al.	**Određivanje sadržaja natrijuma i jodata u komercijalnim kuhinjskim solima** **Determination of natrium and iodate ions content in commercial salts**
17	Cvetanović A. et al.	**Stabljika i lišće hajdučke trave kao izvori novih funkcionalnih sastojaka** **Stalks and leaves of yarrow as sources of new functional ingredients**
18	Cvetanović A. et al.	**Savremen pristup dobijanja funkcionalnih sastojaka kamilice** **Emerging approach for the preparation of chamomile functional ingredients**
19	Caleja et al.	**Hromatografski profil masnih kiselina I šećera u kolačima funkcionalizovanim ekstraktom bogatim ruzmarinskom kiselinom**

		Chromatographic profile of fatty acids and sugars in cupcakes functionalized with an extract rich in rosmarinic acid
20	Đermanović et al.	**Određivanje sadržaja sorbinske i benzojeve kiseline u paradajz sosu HPLC metodom** **Determination of sorbic and benzoic acid in tomato juice by HPLC method**
21	Đikanović et al.	**Koncentracije As, Cd, Cu, Fe, Hg, Pb i Zn u mišićnom tkivu skobalja, klena i soma sa akumulacije Međuvršje** **Concentrations of As, Cd, Cu, Fe, Hg, Pb and Zn in muscle tissue of common nase, chub and wels catfish from the Medjuvršje reservoir**
22	Đorđević et al.	**Poboljšanje kvaliteta bezglutenskog hleba dodatkom vlakana šećerne repe** **Gluten-free bread quality enhancement by sugar beet fibre application**
23	Đuričić et al.	**Određivanje sadržaja nutritivnih komponenti u biljnim uljima** **Determination of nutritive compounds in vegetable oils**
24	Đurović et al.	**ICP-OES analiza ekstrakata lista koprive** **ICP-OES analysis of stinging nettle leaves extracts**
25	Đogo et al.	**Antibakterijska i antioksidativna aktivnost medova iz različitih regiona Srbije** **Antibacterial and Antioxidant Activity of Honeys from Different Regions of Serbia**
26	Doroški et al.	**Antioksidativni potencijal bukovače (*Pleurotus ostreatus)* uzgajane na supstratu sa različitim sadržajem komine grožđa i slame** **Antioxidative potential of the Oyster mushroom (*Pleurotus ostreatus)* cultivated on grape pomace and straw supstrate**
27	Dragišić Maksimović et al.	**Aktivnosti peroksidaza u plodovima maline kao parametar 'funkcionalne hrane''** **Profiling peroxidase activity of raspberry fruit-its association with the functional food**
28	Dramićanin et al.	**Ljuska krompira kao potencijalni izvor prirodnih antioksidanasa** **Potato peel as a potential source of natural antioxidants**
29	Duletić Laušević	**Ekstrakti ruzmarina kao moćni antioksidansi** **Rosemary extracts as potent antioxidant agents**
30	Grabovac et al	**Određivanje sadržaja fluorida u alkoholnim pićima potenciometrijskom metodom** **Determination of fluoride in alcoholic beverages by potentiometric method**

31	Grujić et al.	**Antioksidativne osobine etanolnih ekstrakata *Rubus caesius* L.** **Antioxidant properties of *Rubus caesius* L. ethanol extracts**
32	Horvacki et al.	**Hemisjki sastav lišća jabuke u zavisnosti od ekspozicije svetlosti** **Chemical Composition of Apple Leaves Depending on Light Exposure**
33	Ilić et al.	**Uticaj etarskog ulja i etanolnih ekstrakata bosiljka (*Ocimum basilicum* L.) na oksidativnu stabilnost hladno presovanog suncokretovog ulja u uslovima ubrzanog starenja** **Effect of basil (*Ocimum basilicum* L.) essential oil and ethanolic extracts on the oxidative stability of cold-pressed sunflower oil in accelerated storage conditions**
34	Janković et al.	**Određivanje ^{137}Cs u pečurkama** **^{137}Cs in mushrooms**
35	Katanić et al.	**Novi uvid u fitohemijski profil, antioksidativne osobine i biokompatibilnost metanolnog ekstrakta nadzemnog dela biljke *Salvia verticillata* L** **New insights into the phytochemical profile, antioxidant properties and biocompatibility of *Salvia verticillata* L. aerial parts methanol extract**
36	Knežević et al.	**Antioksidativna aktivnost odbrambenih sekreta stonoga *Pachyiulus hungaricus* (Karsch, 1881) i *Megaphyllum unilineatum* (C. L. Koch, 1838) (Diplopoda, Julida, Julidae)** **Antioxidative activity of defensive secretions of *Pachyiulus hungaricus* (Karsch, 1881) and *Megaphyllum unilineatum* (C. L. Koch, 1838) (Diplopoda, Julida, Julidae)**
37	Krnjaja et al.	**Hemijski sastav i biološka aktivnost odabranih italijanskih vina** **Chemical composition and biological activity of selected Italian wines**
38	Marčetić et al.	**Sadržaj polfenola i antioksidativna aktivnost voćnih čajeva** **The phenolic content and antioxidant activity of fruit teas**
39	Mileski et al.	***Prasium majus* L. iz Libije kao prirodni izvor antioksidanasa** **Libyan *Prasium majus* L. as a natural source of antioxidants**
40	Milićević et al.	**Primena margine izloženosti (MI) pristupa u proceni rizika od aflatoksina M1 u mleku** **Application of the margin of exposure (MoE) approach to risk assessment of aflatoxin M1 in milk**
41	Milićević T. et al.	**Procena sadržaka makro i elemenata u tragovima u dve sorte vinove loze i vinu** **Assessment of major and trace element content in two grapevine species and wine**
42	Mirković et al.	**Upotreba *Lactococcus lactis* subsp. *lactis* BGBU1-4, producenta bakteriocina, u biokontroli *Listeria monocytogenes* i *Staphylococcus aureus* kod sireva u tipu Kvarka**

		Application of bacteriocin-producing *Lactococcus lactis* subsp. *lactis* BGBU1-4 in the bio-control of *Listeria monocytogenes* and *Staphylococcus aureus* in Quark type cheese
43	Nikolić M. et al.	**Farmakološka svojstva jestive biljke *Anthriscus cerefolium* L. Hoffm** **Pharmacological properties of edible plant *Anthriscus cerefolium* L. Hoffm**
44	Oalđe et al.	**Biljke kao prirodni antimikrobni agensi za bezbednost hrane** **Plants as natural antimicrobial agents for food safety**
45	Odović et al.	**Određivanje sadržaja vitamina C u voću** **Determination of vitamin C content in fruit**
46	Okuka et al.	**Određivanje sadržaja kinina u različitim bezalkoholnim osvježavajućim pićima** **Determination of quinine content in various non-alcoholic refreshing drinks**
47	Pagnacco et al.	**Oscilatorna reakcija kao sredstvo za ispitivanje ploda maline (*Rubus idaeus L.*) tretirane različitim vrstama đubriva** **Oscillatory Reaction as Way for Investigation of Raspberry Fruit (*Rubus idaeus L.*) Treated with Various Types of Fertilizers**
48	Pagnacco et al.	**Uticaj voćnih sokova dobijenih iz organskog i konvencionalno gajenog južnog voća na Brigs-Raušer oscilatornu reakciju** **The influence of fruit juices obtained from selected organic and conventional fruits on the Briggs-Rauscher oscillatory reaction**
49	Pejčić et al.	**Izolovanje i ekstrakcija galne kiseline i flavan-3-ola u uzorcima autohtonih sorti groždja „Prokupac“ i „Smederevka“** **Theisolation and various extraction procedure of gallic acid and flavan-3 ole in autothonic „Prokupac“and „Smederevka“ grapes**
50	Pernucic Lučić et al.	**Određivanje sadržaja etanola u alkoholnim pićima metodom Furijeve infracrvene transformacije spektroskopski(FTIR)** **Determination of ethanol content in alcoholic drinks by Fourier-transform infrared spectroscopy (FTIR)**
51	Perušković et al.	**Određivanje glukoze u pićima pomoću amperometrijskog biosenzora sa medijatorom** **Determination of glucose in beverages by amperometric mediated biosensor**
52	Petronijević et al.	**Određivanje fenolnog sastava ekstrakta imele dobijenog subkritičnom vodom**

		Investigation of phenolic composition of mistletoe subcritical water extracts
53	Lusic et al.	**Senzorska analiza meda – Koristan alat za karakterizaciju, određivanje kvalitete i porijekla meda** **Sensory Analysis of Honey – A Useful Tool For Characterization And Determination of Honey Origin**
54	Popović et al.	**Analiza hrane obogaćene ribom namenjenu za ishranu radnih pasa** **Analyzed food enriched with fish for feeding working dogs**
54.	Radivojević et al.	**Uticaj rastvarača na apsorpcione spektre prehrambenih azo boja** **Solvent effect on the absorption spectra of food azo dye**

MOLE SE SVI IZLAGAČI DA POSTAVE SVOJE POSTERE U PERIODU OD 8.30h-9h I SKINU SVOJE POSTERE U PERIOD OD 13h-13.30h KAKO BI IZLAGAČI NAREDNE SEKCIJE MOGLI DA POSTAVE SVOJE POSTERE

(PLEASE SET UP YOUR POSTERS IN THE PERIOD FROM 8:30 AM - 9:00 AM AND TAKE YOUR POSTERS IN THE PERIOD FROM 13h-13,30h)

SEKCIJA: (SCETION) FOOD CHAIN SUSTAINABILITY

DATUM (DATE): Petak (Friday) 14-18h

Mesto (Place): **Rektorat BU, hol I sprat, Studentski trg 1 (Rectory building BU, Hall I Flat)**

1	Ćirić I. et al.	**Uticaj načina gajenja (konvencionalni, organski i integrisani) na polifenolni sadržaj četiri sorte paprika (*Capsicum annuum* L.)** **Influence of cultivation method (conventional, organic and integrated) on polyphenolic content of four sweet pepper (*Capsicum annuum* L.) cultivars**
2	Ćujić et al.	**Očuvanje bioaktivnih jedinjenja aronije metodom sprej sušenja, karakterizacija mikročestica i *in vitro* metoda digestije** **Chokeberry bioactives preservation by spray drying method, microparticles characterisation and *in vitro* digestion method**
3	Dabetić et al.	**Optimizacija postupka ekstrakcije polifenolnih jedinjenja iz semenki grožđa** **Extraction optimization of polyphenols from grape seeds**
4	Dabić Z. et	**Fenolni profil duga trešnjinog drveta** **Phenolic profile of seasoned cherry heartwood staves**
5	Đakonović et al.	**Njeguški pršut, prvi geografski zaštićen proizvod u Crnoj Gori** **Njegus prosciutto, the first geographical-protected product in Montenegro**
6	Đurović et al.	**Elektroanalitičke procedure za kvantifikaciju pesticida u komercijalnim formulacijama** **Electroanalytical procedures for quantification of pesticides in commercial formulations**

7	Dučić and Blagojević	**Toplotni tretmani fermentisanih suvih kobasica u redukciji rizika od najvažnijih bakterijskih alimentarnih patogena** **Heat treatments of dry fermented sausages in risk reduction of the main bacterial foodborne pathogens**
8	Glišić et al.	**Mikrobiološki status mariniranih pilećih filea upakovanih u vacuum** **Microbiological quality of marinated vacuum-packaged chicken breast fillets**
9	Glumac et al.	**Senzorna analiza prirodnih i veštačkih sistema u studiji ljudske percepcije ulja** **Sensory analysis of natural and artificial model systems in human fat perception study**
10	Golijan et al	**Određivanje sadržaja slobodnih polifenola i flavonoida u organski i konvencionalno proizvedenom semenu soje (*Glycine max* L.)** **Determination of free polyphenol and flavonoids content in organic and conventionally produced soybean seed (*Glycine max* L.)**
11	Ivić et al.	**Uticaj vakuum pakovanja na mikrobiološki kvalitet pečenog svinjskog mesa tokom skladištenja** **Effect of vacuum packaging on microbiological quality of cooked pork during refrigerated storage**
12	Javorac et al.	**Metaboliti i degradacioni proizvodi pesticida – značaj kompjuterskih metoda u toksikološkoj proceni rizika od unosa putem hrane** **Computational methods in dietary risk assessment of metabolites/degradates of pesticides**
13	Jovanović et al.	**Efekat *Bacillus safensis* 2.7 na promociju rasta odabranih poljoprivrednih kultura** **The effect of *Bacillus safensis* 2.7 on growth promotion of selected agricultural important plant species**
14	Kocić Tanackov et al.	**Uticaj etarskih ulja bosiljka i kima na makro - i mikromorfološke promene plesni izolovanih sa površine fermentisanih kobasica** **Effect of basil and caraway essential oils on macro - and micromorphological changes of moulds isolated from fermented sausages**
15	Kovačević et al.	**Ocena znanja, stavova i ponašanja studenata veterinarske medicine u vezi sa upotrebom antibiotika** **Assessment of the knowledge, attitudes and behaviours of veterinary medicine students towards antibiotic use**
16	Krstić et al.	**Lipidni profil kao alatka za procenu autentičnosti semena gajenog i divljeg voća** **Lipid profile as a tool for the assessment of authenticity of cultivated and wild fruit seeds**

17	Krunić et al.	**Uticaj dodatka hitozana i proteina surutke u alginatni matriks namenjen inkapsulaciji probiotika na svojstva nosača** **Effect of chitosan and whey protein addition in alginate matrix used for probiotic encapsulation on carrier properties**
18	Mihailović N et al.	**Optimizacija uslova ultrazvučne ekstrakcije fenolnih jedinjenja ploda divlje maline (*Rubus Idaeus* L.): HPLC-PDA analiza i određivanje antioksidativne aktivnosti dobijenog ekstrakta** **Optimization of ultrasonic extraction conditions of phenolic compounds in the wild raspberry extract (*Rubus Idaeus* L.): HPLC-PDA analysis and antioxidant activity determination of the obtained extract**
19	Miladinović et al.	**Preliminarno ispitivanje sastava masnih kiselina u sterilizovanom i pasterizovanom mleku** **Preliminary asssesment of fatty acids composition in sterilized and pasteurized milk**
20	Milenković et al.	**Efekat nanočestica CeO_2 obloženih polisaharidima na rast i ukupni sadržaj fenola kao parametar stresa kod dve vrste useva** **Effect of polysaccharide coated CeO_2 nanoparticles on growth and total phenolic content as a stress parameter of two crop species**
21	Miljković et al.	**Mineralni profil odabranih kupusnjača (*Brassica oleracea*) proizvedenih organskom tehnologijom gajenja** **Mineral profile of selected brassicas (*Brassica oleracea*) grown in the organic production system**
22	Nenadović et al.	**Promotivni potencijal odabranih sojeva *Bacillus* spp. na klijanje semena paprike** **Plant growth promoting effect of selected *Bacillus* spp. strains on pepper seed germination**
23	Nikolić I et al.	**Emulgujuća svojstva vlakana šećerne repe i OSA maltodekstrina u prehrambenim sistemima** **The emulsifying properties of sugar beet fibers and OSA maltodextrin in food systems**
24	Opsenica D. et al.	**Šećerni profil kao pokazatelj uticaja tetraoksana na metabolizam kukuruza u ranim fazama rasta i razvića** **Sugar profile as a tool for the assesment of influence of tetraoxanes on germination and starting growth phase of maize seeds**
25	Pavlić et al.	**Optimizacija mikrotalasne ekstrakcije polifenola iz *Mentha piperita* L. primenom metode odzivne površine** **Optimization of microwave-assisted extraction of polyphenols from *Mentha piperita* L. by response surface methodology**

26	Pavlović et al.	**Određivanje polifenolnog i šećernog profila organski gajene cvekle** **Determination of sugar and polyphenolic profile of organic beetroot**
27	Pejin J et al.	**Mikrosladovanje tritikalea** **Triticale micromalting**
28	Petrović S. et al.	**Uticaj vidljivog i UVB zračenja na *in vitro* stabilnost hlorofilina (E141) u vodenom medijumu** **Influence of visible and UVB irradiation on *in vitro* chlorophylline (E141) stability in aqueous medium**
29	Popović et al.	**Proizvodnja fermentisanog mlečnog napitka sa probiotičkom kulturom *Lactobacillus helveticus* BGRA43** **Production of dairy beverage with probiotic culture *Lactobacillus helveticus* BGRA43**
30	Radibratović et al.	**Stabilizacija apo-alfalaktalbumina prilikom vezivanja epigalokatehin-3-galata: eksperimentalno i molekulsko dinamičko proučavanje** **Stabilization of apo-alpha-lactalbumin by binding of epi-gallocatechin-3-gallate: experimental and molecular dynamics study**
31	Radović et al.	**Uticaj podloge na fenolni sastav i antiosidativnu aktivnost plodova sorti šljive** **Influence of rotstocks on phenolic composition and antioxidant activity of fruits of plum cultivars**
32	Sivčev et al.	**Karakteristike grožđa i vina pet klonova sorte merlo u beogradskom rejonu, Srbija** **Fruit and wines characteristics of the five merlot clones in Belgrade winegorwing region, Serbia**
33	Škaljac et al.	**Uticaj dodatka starter kulture na boju tradicionalne fermentisane suve kobasie (*Petrovská klobása*)** **Effect of starter culture addition on colour characteristic of traditional dry fermented sausage (*Petrovská klobása*)**
34	Šojić et al.	**Uticaj dodatka etarskog ulja korijandera na oksidativnu stabilnost barenih kobasica** **The effects of coriander essential oil on the oxidative stability of cooked pork sausages**
35	Stanimirović et al.	**Antibiofilm aktivnost odabranih uzoraka vina: studija slučaja bakterije *Pseudomonas aeruginosa* PAO1** **Antibiofilm activity of selected wine samples: the case study of the bacterium *Pseudomonas aeruginosa* PAO1**
36	Stanišić et al.	**Uticaj dodavanja konjugovane linolne kiseline u hranu za nosilje na masnokiselinski sastav žumanceta**

		Effect of dietary conjugated linoleic acid on egg yolk fatty acid profile in laying hens
37	Stevanović et al.	**Uticaj liofilizacije na kvalitet i antioksidativni kapacitet jagodastog voća** **Effect of freeze-drying on the quality and antioxidant capacity of berry fruits**
38	Stojanović et al.	**Sezonska variranja u sadržaju ukupnih fenola kod šest sorti salate primenom mikrobiološkog đubriva** **Seasonal variation of total phenolic content in six lettuce cultivars grown with microbiological fertilizer**
39	Tešanović et al.	**Gljive iz prirode i potopljene kultivacije kao izvori fenolnih jedinjenja** **Fungi from nature and submerged cultivation as sources of phenolic compounds**
40	Teslić et al.	**Membransko koncentrisanje ekstrakta biljne prašine žalfije dobijenog ekstrakcijom subkritičnom vodom** **Membrane concentration of sage herbal dust extract obtained by subcritical water extraction**
41	Timić et al.	**Sadržaj dijetnih vlakana u popularnim slanim snek proizvodima sa srpskog tržišta** **Dietary fiber content in popular salty snack products from Serbian market**
42	Unković et al.	**Profil osetljivosti gljiva roda *Fusarium* na odbrambeni sekret stonoge *Pachyiulus hungaricus* (Karsch, 1881) (Diplopoda, Julida, Julidae)** **Antifungal susceptibility profile of *Fusarium* species to defensive secretion of millipede *Pachyiulus hungaricus* (Karsch, 1881) (Diplopoda, Julida, Julidae)**
43	Vakula et al.	**Sušenje breskve (*P. persica*) u vakuumu: Matematičko modelovanje procesa sušenja** **Peach (*P. persica*) vacuum drying: Mathematical modeling of the drying process**
44	Vasić et al.	**Različiti pristupi multivarijantne analize prilikom GC×GC-MS karakterizacije medljikovaca** **Different approaches for multivariate data analysis in GC×GC-MS fingerprinting of honeydew honey**
45	Vasiljević et al.	**Antibakterijski efekat vinskih marinada sa etarskim uljima *Juniperus communis* I *Satureja montana* na kontaminante junećeg mesa**

		Antibacterial activity of red-wine marinades containing *Juniperus communis* and *Satureja montana* essential oils against food contaminants in beef
46	Veličković et al.	**Antimikrobna svojstva ekstrakata *Rubus discolor* i mogućnost njihove primene u konzerviranju hrane** **Antimicrobial properties of *Rubus discolor* extracts and their potential use in food preservation**
47	Veljović et al.	**Aromatični profil i senzorne karakteristike likera od meda** **Aromatic profile and sensory characteristics of honey liquer**
48	Vujićić et al.	**Upotreba briofita u unapređenju kvaliteta i proizvodnje hrane** **The use of bryophytes to improve food quality and production**
49	Žilić et al.	**Sastav i sadržaj antocijanina u zrnu plavog i purpurnog kukuruza. Kukuruz kao „SuperHrana“** **Composition and content of anthocyanins in blue and purple maize grain. Maize as „SuperFood“**
50	Žilić et al.	**α-Dikarbonil jedinjenja kao prekursori krajnjih proizvoda glikacije u keksu na bazi žitarica** **α-Dicarbonyl compounds as precursors of advanced glycation endproducts in cereal cookies**
51	Zlatanović et al.	**Termalna karakterizacija osušenog tropa jabuke** **Thermal characterization of dried apple pomace**
52	Zlatanović et al.	**Određivanje polifenolnog i šećernog profila u uzorku tropa od organski gajenih jabuka** **Determination of sugar and polyphenols profile in apple pomace sample from organic cultivated apples**
53.	Urošević et al.	**Eksperimentalna analiza ultrafiltracije model rastvora voćnog soka u prisustvu promotora turbulencije** **An experimental analysis of ultrafiltration of synthetic fruit juice in presence of turbulence promoters**

MOLE SE SVI IZLAGAČI DA POSTAVE SVOJE POSTERE U PERIODU OD 13.30h-14h I SKINU SVOJE POSTERE U PERIOD OD 18h-18.30h

(PLEASE SET UP YOUR POSTERS IN THE PERIOD FROM 8:30 AM - 9:00 AM AND TAKE YOUR POSTERS IN THE PERIOD FROM 13h-13,30h)

SEKCIJA (SECTION): FOOD and HEALTH

DATUM (DATE): Subota (Saturday) 9-13h

Mesto (Place): **Rektorat BU, hol I sprat, Studentski trg 1 (Rectory building BU, Hall I Flat)**

1	Cvetković et al.	**Etarsko ulje i postdestilacioni ostatak *Juniperus communis*: antibakterijski efekat prema kontaminantima hrane i *in vitro* citotoksični potencijal na humanim ćelijama kolona** ***Juniperus communis* essential oil and post-destilation waste: antibacterial effect against food contaminants and *in vitro* cytotoxicity against human colon cells**
2	Dekanski et al.	**Potencijalni mehanizmi zaštitnog dejstva ekstrakta lista masline kod ugljen tetrahloridom indukovanog akutnog oštećenja jetre pacova** **Potential mechanisms of the protective activity of olive leaf extract in carbon tetrachloride - induced acute liver injury in rats**
3	Đermanović et al.	**Kontaminacija dodataka ishrani** **Contamination of dietary supplements**
4	Đermanović and Bojanić	**Socijalni aspekt celijakije, naša iskustva** **Social aspect of celiac disease, our experience**
5	Đurašević et al.	**Protektivni efekat kokosovog ulja na aloksan-indukovani dijabetes kod pacova** **Beneficial effect of virgin coconut oil on alloxan-induced diabetes in rats**
6	Karaman M et al.	**Antivirusna aktivnost odabranih ekstrakata makrogljive *Trametes versicolor* (L.) LIoyd 1921** **Antiviral activity of the selected extracts of the macrofungal species *Trametes versicolor* (L.) LIoyd 1921**
7	Karaman M et al.	**Osvrt na antimikrobnu aktivnost ekstrakata odabranih autohtonih makrogljiva** **An insight into antimicrobial activity of the extracts of selected autochtonous macrofungi**
8	Karaman R et al	**Osvrt na elementalni sastav odabranih makrogljiva** **An insight into elemental composition of selected macrofungal species**
9	Kostić M. et al.	**Dekokt biljke *Nepeta nuda* kao potencijalni izvor antimikrobnih agenasa** **Decoct of *Nepeta nuda* as potential source of antimicrobial agents**
10	Krga et al.	**Uticaj dijetarnih fenolnih kiselina na markere agonistom indukovane aktivacije trombocita** **Impact of dietary phenolic acids on agonist-induced markers of platelet activation**
11	Marić et al.	**Vodeni ekstrakt gljive *Coprinellus disseminatus* (Pers.: Fr.) S.F. Gray efikasno inhibira enzim acetilholinesterazu** **The aqueous extract of the fungus *Coprinellus disseminatus* (Pers.: Fr.) S.F. Gray effectively inhibits the enzyme acetylcholinesterase**

12	Matejić et al.	**Antioksidativna i antimikrobna aktivnost ekstrakata *Rosa canina* L. sa Vlasinske visoravni** **Antioxidant and antimicrobial activity of *Rosa canina* L. extracts from Vlasina plateau**
13	Mihajilović J. et al.	**Detekcija posttranslacionih modifikacija epitopa glavnih alergena kikirikija masenom spektrometrijom** **Detection of major peanut allergen epitope post-translational modifications by mass spectrometry**
14	Mihajilović V. et al.	**Koren biljke *Salvia verticillata* L. kao potencijalni dijetetski suplement i značajan izvor ruzmarinske kiseline** ***Salvia verticillata* L. root as potential dietary supplement and an important source of rosmarinic acid**
15	Mijušković et al.	**Pirgalol, strukturni motiv u razvoju novog hemoterapeutika** **Pyrogallol, a structural motif in development of new chemotherapeutic**
16	Milivojević et al.	**Transgalaktolizacija laktoze pomoću imobilisanog enzima u pneumatskom reaktoru sa spoljasnjom recirkulacijom** **Transgalactosylation of lactose with immobilized enzyme in external airlift reactor**
17	Mitić Ćulafić	**Efekat devičanskog kokosovog ulja na sastav mikrobite kod pacova** **Effect of virgin coconut oil supplementation on the microbiota composition in rats**
18	Nakarada et al.	**Antiradikalska aktivnost avarola** **Antiradical activity of Avarol**
19	Nastić et al.	***In vitro* ispitivanje antikancerogenih osobina voćnih nusprodukata** ***In vitro* screening of anticarcinogenic properties of fruit by-products**
20	Nikolić B. et al.	***In vitro* antilisterijalni efekat etarskih ulja *Juniperus communis* i *Satureja montana*** **Antilisterial activity of *Juniperus communis* and *Satureja montana* essential oils screened *in vitro***
21	Pereira et al.	**Efekat gama zračenja na fenolni sastav, citotksičnost, antibakterisjku i antivirusnu aktivnost dve medicinske biljke** **Effects of gamma radiation on phenolic composition, cytotoxicity, antibacterial and virucidal activities of two medicinal plants**
22	Pantović et al.	**Suplementacija sokom od aronije pre simulacije polumaratonske trke – da li može povećati ukupni antioksidativni status kod rekreativnih trkača?** **Aronia juice consumption before simulation of a half-marathon race - can it enhance the total antioxidant status in recreational runners?**
23	Pavlović et al.	**Sadržaj beta-glukana i antioksidativna aktivnost dodataka ishrani na bazi gljiva**

		Beta-glucan content and antioxidant activity of mushroom supplements
24	Pinjić et al.	**Od mediteranskog sunđera do antitumorskog sastojka hrane** **From a Mediterranean sponge species to an antitumour food ingredient**
25	Platiša et al.	**Akutni efekat crvenog vina na osobine kardiovaskularnih ritmova kod zdravih osoba** **The acute effect of red wine on the properties of cardiovascular rhythms in healthy subjects**
26	Pualić et al.	**Anti-kvorum aktivnost dopamine i srodnih jedinjenja** **Anti-quorum sensing activity of dopamine and related compounds**
27	Stojadinov et al.	**Osvrt na anti-acetilholinesterazni potencijal gljiva *Agrocybae aegerita* (Briganti) Fayod i *Pleurotus ostreatus* (Jacq.) P. Kumm., 1871** **An insight into anti-acetylcholinesterase potential of the fungi *Agrocybae aegerita* (Briganti) Fayod & *Pleurotus ostreatus* (Jacq.) P. Kumm., 1871**
28	Zrnić Ćirić	**Efekat suplementacije oktakozanolom na indeks oksidativnog stresa kod pacijenata na terapiji atorvastatinom** **Effects of octacosanol supplementation on oxidative stress index in patients on atorvastatin treatment**

MOLE SE SVI IZLAGAČI DA POSTAVE SVOJE POSTERE U PERIODU OD 8.30h-13h I SKINU SVOJE POSTERE U PERIOD OD 13h-13.30h

(PLEASE SET UP YOUR POSTERS IN THE PERIOD FROM 8:30 AM - 9:00 AM AND TAKE YOUR POSTERS IN THE PERIOD FROM 13h-13,30h)

SEKCIJA (SECTION): FOOD QUALITY AND SAFETY

DATUM (DATE): Subota (Saturday) 9-13h

Mesto (Place): **Rektorat BU, hol I sprat, Studentski trg 1 (Rectory building BU, Hall I Flat)**

1	Petrović A et al.	**Uticaj načina prerade grožđa i vinifikacije na sadržaj resveratrola u vinu** **Influence the processing of grapes and vinification of resveratrol content in wine**
2	Radojčić et al.	**Određivanje botaničkog porekla medljikovca na osnovu odnosa stabilnih izotopa ugljenika**

		Botanical discrimination of honeydew honey by stable carbon isotope ratio analysis
3	Radovanović et al.	**Sadržaj sorbitola u crvenom vinu: studija klonske selekcije sorte kaberne fran** **Sorbitol content in red wine: the case study of Cabernet Franc grapevine clonal selection**
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PP1 / PL1

The essential role of natural resources on novel bio-based food additives discovery pathway

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Natural resources are invaluable sources of bio-based molecules with numerous applications in food industry. Some of these compounds have been explored to serve particular purposes such as substituting artificial food additives. In fact, the increasing consumers' awareness and resistance to artificial compounds often used as additives in many foodstuffs has led to renewed strategies to overcome possible safety issues, while guaranteeing effectiveness. Food additives have long been used to enhance foodstuff properties and are of great value to maintain their quality, which justifies the exploitation of safer bio-based compounds to be used as natural substitutes. Plants and mushrooms seem to be a potential source of such compounds, given their unique richness in colouring, preservative, and bioactive molecules.

In this context, several matrices have been studied and certain compounds such as betalains (e.g. gomphrenin II, gomphrenin III, isogomphrenin II, and isogomphrenin III) and anthocyanins (e.g. cyanidin, delphinidin, and malvidin derivatives) were extracted from purple globe amaranth, rose, dahlia, centaurea, strawberry-tree, roselle, and blueberry and were further introduced in ice-cream, yogurt, and waffles for colouring purposes.

On the other hand, preservative molecules such as flavonoids (e.g. catechin, and quercetin and luteolin derivatives), phenolic acids (e.g. rosmarinic, chicoric, lithospermic, caffeic, and caffeoylquinic acids), and hydrolysable tannins (e.g. trigalloyl-HHDP-glucoside) were obtained from strawberry-tree, basil, lemon balm, sweet chestnut flowers, fennel, and German chamomile, and were tested in loaf bread, cupcakes, yogurt, cheese, and cottage cheese, namely. Moreover, phenolic acids (e.g. rosmarinic acid), flavonoids (e.g. quercetin derivatives), and ellagitannins (e.g. sanguiin H-10 and lambertianin) from mushrooms, wild strawberry, rosemary, mountain sandwort, and flowers of *Silva brava* conferred bioactive properties to gelatin, yogurt, and cottage cheese.

The proven efficacy of distinct natural food additives in several foodstuffs highlights the importance of natural resources such as plants and mushrooms in these novel additives discovery journey.

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PP2 / PL2

The microbial ecology of fermented foods: how the technology development changed the way we investigate diversity

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The way the microbial ecology of fermented foods has been investigated has dramatically changed in the last 30 years. We switched from culture-dependent methods, based on cultivation, isolation and identification, to culture-independent approaches, where microorganisms are identified directly in the food matrix without the need of their cultivation.

This big change has been allowed by technologies that either are able to profile the populations in electrophoretic gels or sequence, with high efficiency, mixtures of DNA extracted directly from the food samples. The first ones, mainly represented by Denaturing Gradient Gel Electrophoresis (DGGE), were characterized by poor depth in the coverage of microbial diversity, low throughput and pretty labor-intensive procedure. However the first studies exploiting DGGE already highlighted that what could be seen on agar plates was a little portion of the microbial populations involved in the fermentation process. With the development of the next generation sequencing methodologies, we have now in our hands techniques, that are able to deeply investigate the diversity of microorganism and how they are interacting in a very dynamic ecosystem. Not only we can reconstruct the taxonomic map of the microbes present in a given food, but we can also monitor the metabolic activities that are expressed in a specific time point. The use of metataxonomics, metagenomics and metatranscriptomics have allowed for a huge amount of new data to be generated, which can be analyzed through bioinformatic tools to be able to fully understand the role of the microorganisms.

Nowadays we do have to concentrate our attention and our efforts on the study of whole interactive microbial communities, since the classic approach to focus on a specific population has been demonstrating not valid in several occasions.

PP3 / PL3

OMICS approaches in food safety risk assessment: mixture exposure and host-pathogen interactions

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Recent development of groundbreaking advanced tools in Genomics, Transcriptomics, Proteomics and Metabolomics has opened up new avenues in scientific research generating vast amounts of analytical data. Using several examples the lecture will integrate application of phenomic, transcriptomic and proteomic (OMICS) studies in microbiological and chemical risk assessment in food safety. The primary focus of the presentation is set on original data generated in running project (e.g. Horizon2020 EuroMix, Horizon2020 MycoKey, TR31034, etc) as well as published data. The concept will be illustrated on the cases of residues of plant protection products, mycotoxins and bacterial toxins in absence or presence of respective foodborne pathogen, comprising PPPs such as thiacloprid, imazalil, clothianidin, Fusarium mycotoxin beauvericin, and Bacillus cereus emetic toxin cereulide. The concept and data shown describe and quantitatively determine aspects pertinent to: 1. presence of mixtures of hazards to which food consumer is exposed to, including for example impact of hazard concentrations found in food, impact of extrinsic and intrinsic factors on proliferation of pathogens and toxin production; 2. In-vitro dose-response features for selected hazards using acute and sub-chronic exposure scenarios for low-doses (sub-clinical) doses of hazards and selected toxicological end-points, such as mitochondrial toxicity in intestinal and liver toxicity; 3. Use of in-silico models such as relative potency factors (RPF) to assess toxicity of mixtures and compute margin of exposure (MoE), 4. Risk-benefit consideration based on dose-response and exposure assessment. Finally few words will be given on quantitative impacts of modern food processing as a intervention strategy to reduce risks and maintain benefits, such as UV and cold plasma treatments.

OMICS pristupi u proceni rizika bezbedosti hrane: izloženost kombinacijama opasnosti i interakcije između patogena i domaćina

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Razvoj revolucionarnih alata i tehnologija u oblasti genomike, transcriptomike, proteomike i metabolomike je otvorio nove puteve za generisanje velikog broja analitičkih naučno istraživačkih podataka. Primeri u okviru ovog predavanja će integrisati aplikaciju OMIKS studija u mikrobiološkoj i hemijskoj proceni rizika bezbednosti hrane. Primarni fokus prezentacije je postavljen na originalnim podacima generisanim u tekućim projektima (npr Horizont 2020 “EuroMix”, Horizont 2020 “MycoKey”, itd) kao i podacima iz naucne literature. Koncept će biti ilustrovan na primerima rezidua sredstava za zaštitu bilja, mikotoksina i bakterijskih toksina u odsustvu ili prisustvu odgovarajućeg patogena: tiakloprid, imazalil, klotianidin, Fusarium mikotoksin beauvericin i Bacillus cereus emeticki toksin cereulid. Prikazani koncept i podaci opisuju kvantitativno određivanje aspekata relevantnih za: 1. Kombinovano prisustvo hazarda u hrani kojima je potrošač izložen, uključujući na primer uticaj koncentracija hazarda pronađenih u hrani, uticaj spoljašnjih i unutrašnjih faktora na proliferaciju patogena i proizvodnja toksina; 2. In vitro karakterizaciju odnosa doza-efekat za odabrane opasnosti u akutnim i sub-hroničnim scenarijima izlozenosti malim dozama (sub-kliničke doze) i odabranih krajnjih toksikoloških efekata, na primer mitohondrijlni efekti u gastro-intestinalnoj i jetrenoj toksičnosti; 3. Korišćenje in-silico modela za određivanje relativnih faktora jačine toksičnog efekta pri proceni toksičnosti smeša i izračunavanja granica izloženosti, 4. razmatranje procene rizika i korisnosti na osnovu podataka iz modela doza-efekat i procene izloženosti. Na kraju nekoliko reči će biti rečeno o kvantitativne uticajima savremene prerade hrane (tretmani UV svetlom i hladnom plazmom) kao strateske intervencije u smanjenju rizika bezbednosti hrane i održavanja korisnih aspekata datog prehrambenih proizvoda.

PPP1 / IL1

Nedigestibilne komponenate hrane i njihov značaj za stimulaciju simbiotske aktivnosti crevne mikrobiote

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Crevna mikrobiota je kompleksan ekosistem sačinjen od nekoliko stotina različitih vrsta mikroorganizama, čija metabolička aktivnost značajno doprinosi sistemskom zdravlju čoveka. Dugo se smatralo da je funkcija microbiote ograničena na doprinos efikasnosti varenja kroz ekstrakciju energije iz nedigestibilnih jedinjenja. Imajući u vidu da nedigestibline komponente hrane usporavaju asimiliaciju vitamina, minerala i drugih mikronutrijenata, one su smatrane smatrane antinutrijentima i uklanjane su različitim tehnološkim postupcima. Ovo je trebalo da doprinose poboljšanju zdravlja čoveka, ali je praksa pokazala da je u najrazvijenijim zemljama u poslednjih nekoliko decenija došlo do ekspanzije hroničnih nezaraznih bolesti. Danas postoje naučni dokazi da je većina ovih bolesti povezana sa neadekvatnom aktivnošću mikrobiote, najčešće usled promena u ishrani. Neophodnost postojanja nedigestibilnih komponenata hrane je evidentna i kroz činjenicu da prva hrana čoveka – majčino mleko – sadrži preko 100 različitih nesvarivih oligosaharida, koji služe kao supstrat za rast mikrobiote. Na ovaj način se obezbeđuje mikrobiološka aktivnost koja dopunjuje metabolizam čoveka kroz niz procesa uključujući sintezu esencijalnih aminokiselina i vitamina K i B grupe. Mikrobiota razlaganjem nedigestibilnih ugljenih hidrata proizvodi masne kiseline kratkog lanca (engl. SCFAs – short chain fatty acids) koje deluju antiinflamatorno, utiču na integritet zida creva i sprečavaju prekomernu propustljivost koja može dovesti do sistemske intoksifikacije i razvoja metaboličkih poremećaja. SCFAs deluju kao regulatori sitosti a preko osovine crevo-mozak utiču na energetsku heomeostazu. Pored toga SCFAs su neophodne za indukciju sinteze preko 80% ukupnog serotonina, čime mikrobiota utiče na pokretljivost creva ali i na moždane funckcije i osećaj zadovoljstva. Iako svi mehanizmi delovanja nisu razjašnjeni, jasno je da je crevna mikrobiota izuzetno značajan faktor u ostvarivanju zdravstvenih efekata hrane.

Indigestible food components and their role in promoting symbiotic activity of gut microbiota

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Gut microbiota is a complex ecosystem composed of hundreds of different microbial species, which metabolic activity significantly contributes to our systemic health. For a long period of time, the function of microbiota was considered to be limited to energy extraction from indigestible food components. Since these components hamper assimilation of micronutrients (including vitamins and minerals), indigestible food components were considered to be antinutrients and were removed using different procedures. Although this was intended to be health beneficial, the incidence of chronic diseases has increased dramatically, especially in the developed counties. Scientific evidence shows that most of these diseases are linked to (if not caused by) inadequate microbiota activity, which is caused by changes in food habits. Indigestible food components are indispensable for our wellbeing and this is probably the best evident from the fact that our first food – mothers' milk – contains over 100 different resistant oligosaccharides that serve as substrate for microbial growth. This facilitates microbial metabolic activity that complements ours in several ways including essential amino acids and vitamins K and B synthesis. Short chain fatty acids (SCFAs) are the predominant products of carbohydrate fermentation by gut microbiota. SCFAs show anti-inflammatory effects, promote gut wall integrity and therefore prevent leaky gut phenomenon that can result in endointoxication and metabolic dysfunction. SCFAs also act as satiety sensation molecules that regulate energy homeostasis via gut-brain axis. Furthermore, SCFAs are essential metabolites needed for serotonin synthesis induction. The gut originating serotonin regulates gut movement but also the brain function and the mood. Although the exact mechanisms underlying microbiotas impact on health are still to be elucidated it is clear that microbiota is an important mediator of dietary induced health effects.

PPP2 / IL2

Jestive i lekovite gljive – uticaj na zdravlje ljudi

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Hipokratova fraza "Neka hrana bude lek, neka lek bude hrana", izgovorena pre više od 2500 godina, i danas je aktuelna, jer potrošači hrane i naučnici shvataju zdravstveni značaj hrane.
Od drevnih vremena, gljive su deo ljudske kulture, hrane, lekova, legendi, folklora i religije. Stari Grci verovali su da obezbeđuju snagu ratnicima u borbi, a Rimljani su ih smatrali "hranom bogova". Vekovima, kineska kultura koristi gljive kao zdravu hranu ili za lečenje bolesti u tradicionalnim narodnim lekovima. Interesovanje za jestive i lekovite vrste makromiceta je veoma povećano u poslednjim decenijima prošloga veka. Danas naučne studije pokazuju da makromicete su visoko vrednovana hrana, jer imaju nizak sadržaj masti i energetsku vrednost. Bogate su ugljenim hidratima, vitaminima, mineralima i dijetetskim vlaknima, a prisutni proteini u makromicetama sadrže devet esencijalnih amino kiselina. Takođe, one su relativno dobar izvor minerala kao što su kalijum, fosfor, gvožđe, i vitamina (tiamin, riboflavin, askorbinsku kiselinu, ergosterol i niacin). Različite vrste gljiva stvaraju veliki broj bioaktivnih jedinjenja velike i/ili male molekulske mase. Neka od njih, kao što su polisaharidi, peptidi i proteini, posebno lektini, kao i mnoga terpenoidna jedinjenja pokazuju različite biološke aktivnosti, uključujući antitumorsku, imunomodulatornu, kardioprotektivnu, hepatoprotektivnu, hipoholesterolemičnu, antivirusnu, antibakterijsku, antifungalnu, antiparazitsku i antidijabetičnu.
Mnoge jestive i lekovite vrste gljiva predstavljaju potencijalni izvor velikog broja bioaktivnih jedinjenja koja se mogu koristiti kao profilaktički agensi u prevenciji oboljenja i zaštiti ljudskog zdravlja.

Edible and medicinal mushrooms - The beneficial role for human health

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Hippocrates's phrase "Let food is the medicine and medicine be the food," pronounced more than 2500 years ago, it is still interesting today, because food consumers and scientists realize the health benefits of food.
Since ancient times, mushrooms have been part of the human culture, as food, as medicine, as legends, and in folklore and religion. Thus, ancient Greeks believed that mushrooms provided strength for warriors in battle, and the Romans perceived them as the "Food of the Gods." For centuries, the Chinese culture has treasured mushrooms as a health food or for disease treatment in traditional folk medicines. In the last decade, the interest of edible and medicinal mushrooms has been increased rapidly. Today, scientific studies consider mushrooms as healthy, having low fat content and energy value, rich in carbohydrates, vitamins, minerals and dietary fibers. Mushrooms content protein with all the nine essential amino acids required by humans. Also, they are a relatively good source of the nutrients like phosphorus, iron and vitamins, including thiamine, riboflavin, ascorbic acid, ergosterol, and niacin. Various mushroom species produce multitude of bioactive compounds classified as high and/or low molecular weight compounds depending on their molecular weight. Some of them, such as polysaccharides, peptides and proteins, specially lectins, as well as many terpenoid compounds display various biological activities, including antitumour, immunomodulating, cardiovascular, hepatoprotective, hypocholesterolemic, antiviral, antibacterial, antifungal, antiparasitic and antidiabetic.
Many edible and medicinal mushrooms are used to protect human health and like as mini-pharmaceutical factories producing compounds with miraculous biological properties. As one of the most prominent functional food might have a big potential for the prevention and/or cure of some diseases.

PPP3 / IL3

Masena spektrometrija kao fudomički alat za istraživanje i kontrolu proteinskih alergena hrane

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Alergije izazvane pojedinim proteinima hrane pogađaju 2-4% populacije zapadnog sveta i predstavljaju značajan socio-ekonomski problem. Dodatno, biotehnološki pristupi fokusirani na podmirivanje rastućih zahteva za hranom, kao što je genetički inženjering ili nove metode obrade hrane, uvode u lanac ishrane nove proteine ili njihove proteoforme koji su potencijalni alergeni. Koncept-omiks pristupa u analizi hrane, fudomiks, ima za cilj poboljšanje dobrobiti, zdravlja i pouzdanosti potrošača primenom naprednih tehnologija. Jedna od njih, trenutno najbrže rastuća, je tandemska masena spektrometrija (MS) spregnuta sa tečnom hromatografijom. Maseni spektrometri su kompleksni analitički uređaji kojima je moguće identifikovati i kvantifikovati pojedinačne alergene hrane prisutne u niskim, ali biološki bitnim, koncentracijama. Analitičke mogućnosti pojedinačnih masenih spektrometara zavise od tipa masenog spektrometra i obučenosti osoblja. Primena MS metoda kontrole alergena u hrani podrazumeva uzorkovanje hrane, pripremu uzorka, snimanje masenih spektara i bioinformatičku analizu masenih spektara. Većina MS metoda za kontrolu prisutnosti proteinskih alergena u hrani zasniva sa na proteolizi uzorka i ciljanom prikupljanju masenih spektara praćenjem selektovanih reakcija. Razvoj ovih MS metoda zahteva precizno poznavanje strukture alergena i njihovih posttranslacionih modifikacija (uključujući i one nastale u procesu obrade hrane), dizajn standarda za kvantifikaciju, optimizaciju uzorkovanja i pripreme uzoraka za pojedinačne vrste namirnica i tip njihove pripreme kao i detaljnu validaciju metode. Novi kvantitativni pristupi, kao što je paralelno praćenje reakcija, razvijeni na masenim spektrometrima ultra-visoke rezoulcije bitno olakšavaju razvoj MS metoda. Tokom poslednjih 20 godina MS je postala nazaobilazna tehnologija u određivanju strukture proteinskih alergena hrane, identifikaciji novih, proceni njihovog alergenog potencijala (npr. profilisanje peptida vezanih za glavni kompleks histokompatibilnosti dendritičnih ćelija nakon izlaganja alergenu), kao i istraživanjima bioloških mehanizama alergenosti. Dva su glavna pristupa u ovim istraživanjima, analiza na nivou intaktnih proteina i analiza peptida generisanih specifičnom proteolizom proteoma. U ovom drugom pristupu, danas dominantnom, razvijen je niz metoda prikupljanja masenih spektara (klasifikovanih kao zavisne, ciljane i nezavisne) kako bi se približili analizi kompleksnosti proteoma neophodnoj za razumevanje bioloških procesa kao što su i alergijske reakcije.

Mass spectrometry as foodomics tool in research and control of food allergen proteins

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Food allergy caused by certain food proteins affects 2-4% of population in the western world and they represent important socio-economic problem. Additionally, biotechnological approaches focused to meet growing demands for food, such as genetic engineering or new food processing technologies, introduce into the food chain new proteins or their proteoforms which are potential allergens. Concept of –omics approach in food analysis, foodomics, aims to improve consumer's well-being, health, and confidence by implementation of advanced technologies. One such, currently fastest growing, is tandem mass spectrometry (MS) coupled to liquid chromatography. Mass spectrometers are complex analytical devices that enable identification and quantification of individual food allergens present in small, but biologically relevant, concentrations. Analytical capabilities of individual mass spectrometers depend on the type of mass spectrometer and skills of analyst. Application of MS in control of food allergens includes sampling, sample preparation, acquisition of mass spectra and bioinformatics analysis of mass spectra. The majority of MS methods for control of food allergens are based on bottom-up approach with targeted selected reaction monitoring acquisition. Development of these MS methods requires detailed knowledge of allergen structure, its posttranslational modifications (including those arose during food processing), design of quantification standards, optimization of sampling and sample preparation for individual type of food and food processing, as well as thorough method validation. The new approaches, such as parallel reaction monitoring, developed on ultra-high resolution mass spectrometers substantially facilitate development of MS methods. Over last 20 years MS become the main technology for determination of the structure of food allergens, identification of new allergens, assessment of their allergenic potential (e.g. profiling of peptides incorporated into MHC of dendritic cells after exposure to individual allergen), and research of biological mechanisms of allergy. Two main approaches are analysis at the level of intact proteins (top down) and analysis of peptides generated by specific proteolysis of proteome (bottom-up). In the second one, that is currently dominant, a range of methods are developed for acquisition of mass spectra (data dependent, targeted and data independent) in order to approach high complexity of proteome which is a prerequisite for understanding of complex biological processes including allergies.

PPP4 / IL 4

Struktura i funkcija proteinskih kompleksa nastalih tokom obrade mleka

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U mnogim tehnološkim postupcima, termički tretman mleka i mlečnih proizvoda je jedna od osnovnih tehnoloških operacija, koja ima za cilj produženje roka upotrebe, poboljšanje bezbednosti i/ili poboljšanje funkcionalnih svojstava finalnih proizvoda. Kada se mleko izloži temperaturama iznad 70°C, serum proteini denaturišu. Denaturisani serum proteini su skloni reakcijama asocijacije, zbog čega reaguju između sebe ili sa kazeinima. Krajnji proizvod ovih reakcija je formiranje kompleksa između denaturisanih serum proteina i kazeina (pre svega κ-CN) preko hidrofobnih i disulfidnih veza. Nastali kompleksi mogu biti vezani za kazeinsku micelu ili rastvoreni u serum fazi mleka. Količina formiranih kompleksa, njihov sastav i distribucija između micelarne i serum faze mleka zavisi od mnogih tehnoloških faktora kao što su: pH, temperatura i vreme termičkog tretmana, sastava i vrste mleka. Termički-indukovani proteinski kompleksi utiču na mnoge tehnološke postupke proizvodnje mlečnih proizvoda poput sira, jogurta, UHT mleka i funkcionalnih ingredijenata.

U kravljem mleku udeo rastvorljivih i micelarno vezanih kompleksa raste odnosno smanjuje se sa povećanjem pH mleka. Veličina formiranih kompleksa smanjuje se sa povećanjem pH mleka, a njihova struktura varira od globularne do izdužene forme. Tokom enzimske koagulacije termički tretiranog kravljeg mleka himozinom, ovi kompleksi sprečavaju blisko približavanje kazeinskih micela delujući sterno kao stabilizatori micela, dok kod kiselih gelova formiraju mostove između kazeinskih micela, rezultujući formiranju čvršćih gelova sa smanjenim sinerezisom. S druge strane, termički-indukovani kompleksi u kozjem mleku manje su osetljivi na promene pH mleka, uglavnom su locirani na površini kazeinske micele, uniformno distribuirani po njenoj površini, a sastoje se od denaturisanih serum proteina, κ-CN, α_{s2}-CN and β-CN. Ovi kompleksi ne ometaju delovanje sirila i formiranje gela, ali je struktura gruša slabija od gruša termički tretiranog kravljeg mleka. Struktura kiselih gelova kozjeg mleka je krtija i podložnija deformaciji od kiselih gelova nastalih od termički tretiranog kravljeg mleka. Termički-indukovani proteinski kompleksi takođe utiču i na druga tehno-funkcionalna svojstva mleka kao što su emulgujuća i peniva, na tehnološka svojstva poput proteolize tokom zrenja sireva ili digestije u gastrointestinalnom traktu.

Tehnološki postupci obrade mleka uglavnom zavise od površine kazeinske micele, njene reaktivnosti i struktura koje se formiraju na njenoj površini. Kazeinske micele su u osnovi mnogih tehnoloških postupaka obrade mleka, bilo da se spreči njihova agregacija (prilikom skladištenja UHT mleka) ili stimuliše agregacija i formiranje struktura (kod proizvodnje sireva i jogurta). Bolje razumevanje unutrašnje strukture micele kao i strukture površine kazeinske micele omogućiće bolje kotrolisanje proizvodnje mlečnih proizvoda i njihove digestije.

Structure and function of milk protein complexes generating during milk processing

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One of the essential operations in most dairy processes is heat treatment of milk and dairy products. This operation is applied either to enhance techno-functional properties of final products or to ensure their safety and shelf life. During heating above 70°C denaturation of whey proteins occurs. The denatured whey proteins have increased susceptibility to association reactions, thus interact with each other and with the casein micelles. The end product of these reactions is formation of hydrophobic- and disulphide-linked complexes mainly between denatured whey protein and caseins (predominantly with κ-CN) which could be attached to the micelles or remained soluble in serum phase of milk. The amount of formed complexes, their composition and distribution between the micellar and the serum phases of milk depend on various technological factors such as pH, temperature and time of heating, composition and type of milk. Heat-induced protein complexes affect many dairy processes such as cheesemaking, yoghurt-making, storage of UHT milk and preparation of functional ingredients.

In bovine milk, the proportion of soluble and micelle-bound complexes respectively increase and decrease, as the pH of heating increases, whereas the size of complexes decreased with increasing pH and their structure varied from globular to elongated. These complexes act as steric stabilizing agents and prevent the close approach of the micellar surfaces of heated bovine milk during coagulation with chymosin, whereas in acid-induced coagulation they form bridges between the casein micelles, giving a much stronger gel with lower tendency to syneresis. On the other hand, the heat-induced complexes in caprine milk are less influenced by pH of milk, mainly located on the surface of casein micelles, uniformly distributed on the surfaces and composed of denatured whey proteins, κ-CN, α_{s2}-CN and β-CN. These complexes do not hinder the action of rennet and the formation of rennet-induced gels, but the curd structure is weaker than that of heated bovine milk. The structure of acid gel from heated caprine milk is more fragile and less resistant to deformation than that of heated bovine milk. Other techno-functional properties of milk such as emulsifying and foaming properties, technological properties such as proteolysis during ripening of cheeses or digestion in gastro-intestinal tract are also affected by the heat-induced protein complexes.

It is evident that the processing of milk depends mostly on the casein micelle surface, its reactivity and the structures that are formed on its surface. The casein micelles are the basis of many dairy processes, either to avoid their aggregation (in case of storage of UHT milk) or to promote aggregation and structural formation (as in cheese and yoghurt manufacture). We need to be able to understand the interior of casein micelle and what is on its surface to better control dairy processes and digestibility of dairy products.

PPP5 / IL5

Primena naučnih istraživanja u razvoju koncepta funkcionalne hrane

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Poslednjih decenija, značajnim napretkom nauke o hrani i ishrani, utvrđen je značaj optimalno balansirane ishrane ne samo u zadovoljenju nutritivnih potreba organizma, već i u prevenciji bolesti. Naime, savremeni način života se povezuje sa nepravilnom ishranom, koja uz fizičku neaktivnost, doprinosi nastanku brojnih hroničnih nezaraznih bolesti. U cilju promocije zdravlja i prevencije bolesti, uz istovremeno smanjenje troškova lečenja i poboljšanje kvaliteta života, sve je veće interesovanje za razvojem novih namirnica, čijim redovnim konzumiranjem u uobičajenim količinama, se mogu postići pozitivni zdravstveni efekti.

Iako ne postoji univerzalno prihvaćena definicija, hrana se može smatrati funkcionalnom ukoliko je naučno potvrđeno da pozitivno utiče na određene funkcije u organizmu, pored njenog uobičajenog nutritivnog delovanja. Pozitivni efekti funkcionalnih namirnica vezuju se za prisustvo jednog ili više, nutritivnih ili ne-nutritivnih, biološki aktivnih sastojaka. Pristupi koji se najčešće primenjuju u razvoju funkcionalne hrane obuhvataju: prirodno povećanje sadržaja funkcionalnih sastojaka posebnim uslovima uzgoja, ishrane, genetskih modifikacija i sl., obogaćivanje ili fortifikaciju, modifikaciju prirode ili bioraspoloživosti sastojaka, delimičnu ili potpunu eliminacija ili zamenu sastojaka sa utvrđenim nepovoljnim delovanjem, kao i razvoj novih funkcionalnih proizvoda. U cilju dobijanja novih izvora biološki aktivnih sastojaka, naročito su značajna istraživanja biološke aktivnosti i hemijska karakterizacija različitih sirovina prirodnog porekla (biljnog, životinjskog, mikroorganizmi ili proizvodi njihovog metabolizma), uz istovremeni razvoj novih i unapređenje postojećih postupaka ekstrakcije. Na osnovu istraživanja biološke raspoloživosti, biološki aktivni sastojci se dodaju u namirnice, u količinama i u oblicima, kojima se obezbeđuje postizanje određenih efekata i bezbednost u pogledu delovanja funkcionalnih namirnica s jedne, odnosno održava stabilnost i organoleptička prihvatljivost proizvoda s druge strane. U cilju obezbeđivanja zdravstvenih izjava koji se vezuju za funkcionalne namirnice a kojima se sugeriše, tvrdi ili ukazuje na odnos koji postoji između hrane ili sastojaka hrane i zdravlja, neophodno je sprovođenje relevantnih studija u humanoj populaciji. Dodatni aspekt u istraživanjima zdravstvenih efekata hrane, predstavlja definisanje validnih, reproduktivnih, senzitivnih i specifičnih biomarkera dijetarnog unosa određenih namirnica, odnosno njihovih biološki aktivnih sastojaka.

Application of scientific research in the development of the functional foods concept

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In the last decades, in parallel with an advance of the food science and nutrition, the role of diet has been changed from providing of necessary nutrients to disease prevention. The modern lifestyle linked to unhealthy diet and physical inactivity contributes to the risk of numerous chronic non-communicable diseases. In order to reduce the cost of health care and improving the quality of life, there is a growing interest in the development of the functional foods concept.

Although there is no general adopted definition, food can be regarded as functional if it is demonstrated to health benefits beyond adequate nutritional effects. The components responsible for a beneficial effect of foods on health are nutritive and/or non-nutritive biologically active compounds. In addition to natural foods with documented scientific evidence of favorable health effects, innovation applied to the development of the concept of functional food include: naturally enhanced in the content of functional ingredients by growing condition, enrichment or fortification, modification of nature or bioavailability components, partial or complete removing or replacement of ingredients with adverse effects, as well as the development of new functional products.

In order to address new sources of functional ingredients, research into the biological activity and chemical characterization of a wide variety of natural sources (plant, animal, microorganisms or their metabolic products) are particularly important, as well as the development of new or improvement of existing the extraction methods. On the results of bioavailability studies, biologically active compounds added to foods in quantities and in form, which ensure the achievement of beneficial effects and safety of the functional foods. The stability and shelf life of the product, as the organoleptic aspects, must be also considered in the ingredient/food design. It is necessary to conduct relevant clinical trials, which support health claims related to a functional food. Well-validated, reproductive, sensitive and specific biomarkers to dietary intake of certain foods/ ingredients are necessary for investigation of beneficial effects in human dietary intervention studies.

PPP6 / IL6

Vino i zdravlje

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Vekovima unazad, crveno vino je korišćeno u različite terapeutske svrhe i široko su proučavana njegova farmakodinamska dejstva. Pokazalo se da rezveratrol (RES), biološki aktivan polifenol crvenog vina, pomaže u prevenciji mnogih oboljenja. RES širi izolovane arterije i vene čoveka i životinja na više načina. Izaziva endotel-zavisnu relaksaciju stimulacijom sinteze endotelnog NO i hiperpolarišućeg faktora i endotel-nezavisnu relaksaciju posredovanu kalijumovim kanalima u membrani ćelija vaskularnih glatkih mišića (veliki Ca^{2+} -aktiviran K (BKCa) kanal, voltažno zavisne K (Kv), ATP-osetljivih K (K_{ATP}) i barium-hlorid (Kir) i kalcijumove kanale). Takođe, glatko mišićni Ca-kanali i/ili mobilizacija Ca^{2+} u ćeliji mogu biti uključeni u efekte RES na na portalnu i feto-placentalnu cirkulaciju. RES sprečava i patološku hiperkontraktilnost materice i inhibira oksitocinske kontrakcije materice preko interakcije sa kalijumovim kanalima. U eksperimentalnim modelima hipertenzije u životinja, RES snižava arterijski krvni pritisak, štiti endotel, popravlja bioraspoloživost NO i poboljšava protok krvi u aorti. Takođe, sprečava pojavu patoloških morfoloških promena *tunica media* aorte i ispoljava anti-inflamatorna i anti-apoptotska svojstva. Kod zdravih dobrovoljaca konzumacija (200 ml) crvenog vina vrste kaberne sovinjon, sa visokom koncentracijom RES i ukupnih polifenola, je dovela do pada krvnog pritiska i redukcije kompleksnosti RR i QT intervala, ali ne produženjaQT intervala, što je faktor rizika za nastanak srčanih aritmija. Pošto RES deluje povoljno na brojne kardiovaskularne parametre, može se pretpostaviti da ima terapeutski potencijal u različitim oboljenjima. Naša istraživanja potvrdjuju prethodne preporuke da umerena potrošnja crvenog vina bogatog RES ima blagotvorni efekat na zdravlje.

Wine & Health

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Centuries ago, wine was used to treat various health conditions. Wine, and especially red wine, has been studied extensively. Resveratrol (RES) might be a key ingredient in red wine that helps preventing many diseases. In isolated arteries and veins endothelium-dependent relaxation in response to RES include stimulation of endothelial NO production, whereas endothelium-independent vasorelaxation of diffrent arteries is mediated by potassium channels in the membrane of vascular smooth muscle cells, including big Ca^{2+}-activated K (BK_{Ca}), voltage-gated K (Kv), ATP-sensitive K (K_{ATP}) and barium-chloride-sensitive (Kir) channels. In addition, the smooth muscle Ca-channels and/or Ca^{2+} mobilizing through cells might be involved in the effects of RES on the contractility of portal and feto-placental circulation. Uterine abnormal contractility could be prevented by RES inhibition of spontaneous rhythmic and oxytocin-induced contraction involving different K channels. In animal models of hypertension, RES attenuates high blood pressure, preserves vascular endothelial cells, improves bioavailability of NO and reduces aortal vascular resistance. Also, ameliorated morphological changes in the *tunica media* and exerts anti-inflammatory and anti-apoptotic effect. Consumption of red wine (200 ml) with high concentration of RES and total polyphenols by healthy volunteers decreased both BP and reduced complexity of RR and QT series, but didn't prolong QT interval and produce cardiac arrhythmias. Because RES has been shown therapeutic potential in different pathologic conditions of cardiovascular system, moderate consumption of red wine or RES could gave beneficial effect on health.

PPP7 / IL7

Probiotička svojstva laktobacila proizvođača egzopolisaharida i njihova primena u funkcionalnoj hrani

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Probiotici su definisani kao živi mikroorganizmi koji ako se unesu u odgovarajućim količinama doprinose poboljšanju zdravstvenog statusa domaćina. Laboratorija za molekularnu mikrobiologiju ima veliku kolekciju prirodnih izolata bakterija mlečne kiseline (BMK) i već duži niz godina se bavi izučavanjem probiotičkih osobina koje u velikoj meri zavise od površinskih karakteristika bakterijske ćelije. *Lactobacillus paraplantarum* BGCG11 na svojoj površini ima egzopolisaharid EPS-CG11 dok derivat ovog soja dobijen čišćenjem plazmida BGCG11-NB1 (Muc$^-$ derivat) produkuje znatno manje EPS-CG11. BGCG11 indukuje antiinflamatorni ili imunosupresivni odgovor u ćelijama domaćina dok Muc$^-$ derivat pokazuje viši proinflamatorni odgovor u leukocitima periferne krvi. EPS-CG11 pojačava zaštitni efekat urođene mukusne membrane jer smanjuje kontakt patogena sa intestinalnim epitelijalnim ćelijskim linijama. Zanimljivo je da dijabetični pacovi tretirani sojem BGCG11 pokazuju niži nivo hiperglikemije, glikozilovanog hemoglobina i triacilglicerola. Uopšteno, BGCG11 je poboljšao stanje poremećene redoks homeostaze, inflamacije i fibroze uzrokovane dijabetesom. EPS-CG11 je pokazao i antihiperalgezičan efekat na pacovima što je, koliko je nama poznato, prvi put pokazano za bakterijski EPS. Neke vrste roda *Lactobacillus*, koje su prirodno prisutne u gastrointestinalnom traktu i fermentisanoj hrani, imaju sposobnost da adsorbuju teške metale i na taj način doprinose detoksikaciji. Takođe, egzopolisaharidi bakterija mogu da se koriste za uklanjanje jona teških metala. Tako je pokazano da živi sojevi *Lactobacillus paraplantarum* BGCG11 i njegov Muc$^-$ derivat NB1 ostvaruju kompletnu zaštitu od efekta jona kadmijuma na Caco-2 intestinalnoj ćelijskoj liniji. Još jedan producent egzopolisaharida, soj *Lactobacillus plantarum* BGAN8, ostvaruje isti zaštitni efekat zahvaljujući svojim površinskim molekulima.

Probiotic Applications of Exopolysaccharides-Producing Lactobacilli in Functional Food

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Probiotics are defined as live microorganisms that are claimed to provide benefits on the host when consumed in adequate amounts. The Laboratory for Molecular Microbiology has a huge collection of natural isolates of lactic acid bacteria (LAB) that are fully characterized for probiotic potential. Taking into account that probiotic potential is highly dependent on the surface characteristics of bacterial cells, we have studied *Lactobacillus paraplantarum* BGCG11 that produces exopolysaccharide EPS-CG11 together with its Muc$^-$ derivative BGCG11-NB1 obtained by plasmid curing. This derivative produces a far less amount of EPS-CG11. BGCG11 showed an anti-inflammatory or immunosuppressory profile whereas the Muc$^-$ derivative induced higher pro-inflammatory response in peripheral blood lymphocytes. We assume that the physical-protective EPS-CG11 layer acts towards the reinforcement of the innate mucosal barrier which diminishes the contact of the pathogens with the epithelial cells lines. It is interesting that diabetic rats fed with BGCG11 exhibited decreased hyperglycemia, glycated haemoglobin and triacylglycerols. Overall, BGCG11 had an ameliorating effect on diabetes-associated disturbed redox homeostasis, inflammation and fibrosis. EPS-CG11 has an antihyperalgesic effect on rats which is, to our knowledge, the first study to show this novel property of bacterial EPS. Some lactobacilli present in the human gastrointestinal tract and in fermented foods, have the ability to bind and detoxify heavy metal ions. This phenomenon is also demonstrated for bacterial EPS. We have shown that live *Lactobacillus paraplantarum* BGCG11 and its Muc$^-$ derivative NB1 have protective role from cadmium ions on Caco-2 intestinal cell line. Another EPS producer *Lactobacillus plantarum* BGAN8 exhibited the same protective effect which is also dependent on its surface molecules.

PPP8 / IL8

Hemometrija u fudomici

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Razvoj efikasne i pouzdane analitičke metode zahteva hemometrijski pristup na nekoliko nivoa, počevši od primene eksperimentalnog dizajna i tehnike optimizacije za korak ekstrahovanja i razdvajanja komponenata, preko akvizicije podataka i manipulacije signala, do rešavanja problema klasifikacije i modelovanja. U prethodnom periodu, hemičari koji se bave analizom hrane koriste sve veći broj savremenih analitičkih instrumenata za brzo analiziranje velikog broja uzoraka pri čemu se dobijaju velike količine informacija za relativno kratko vreme. Multivarijantne matrice podataka dobijene na taj način zahtevaju upotrebu savremenih statističkih procedura za njihovu obradu kako bi se iskoristile sve korisne informacije sadržane u eksperimentalnim rezultatima. Kada su podaci pravilno snimljeni, preuzeti iz softvera instrumenta i prethodno obrađeni, brojne metode klasifikacije i regresije, kao što su analiza glavnih komponenti, hijerarhijska klasterska analiza, linearna diskriminantna analiza, k-najbliži susedi, klasifikaciona i regresiona stabla, neuronske mreže, regresija metodom delimičnih-najmanjih kvadrata, itd, primenjuju se za analizu rezultata. Poslednjih godina raste interesovanje istraživača za korištenje analitičkih tehnika u kombinaciji sa multivarijantnom analizom kao alatke za dobijanje „otiska prsta" različitih prirodnih proizvoda. Važan korak u takvoj analizi je postupak obrade slike kojom se vrši prevođenje hromatograma u numerički set podataka. U tom smislu biće istaknuta obrada slika na primeru HPTLC i 2D GC×GC profila kroz objašnjenje načina za uklanjanje osnovnog šuma, efekta pozadine, poravnavanje ciljanih pikova i normiranje.

Chemometrics in foodomics

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Development of efficient and reliable analytical method requires chemometric approach at several levels starting with application of experimental design and optimization techniques for the separation step, followed by data acquisition, and signal manipulation, and finally solving classification and modelling problem. During the last period, food chemists have been using an increasing number of modern analytical instruments to analyse high number of samples quickly and obtain a great deal of chemical information in a relatively short time. Multivariate data matrices obtained in that way require the use of contemporary statistical procedures, in order to efficiently extract the maximum useful information from experimental results. Once the data have been properly recorded, extracted, and pre-treated, numerous classification and regression methods such as principal component analysis, hierarchical cluster analysis, linear discriminant analysis, partial least square discriminant analysis, k-nearest neighbours, classification and regression trees, artificial neural networks, partial least square regression, etc., have been applied. Recently, there is an increasing scientific interest for the use of analytical techniques in combination with multivariate analysis, as a tool for fingerprint of different natural products. Important step in such analysis is image analysis procedure for transformation of chromatograms to numerical data set. In that sense, image analysis of HPTLC and 2D GC×GC profiles through baseline removal, denoising, target peak alignment and normalization steps will be pointed out.

POS1 / RTL1

Nauka i znanje – alat u proizvodnji visokovredne hrane

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Tehnologija uzgoja gljiva stara je nekoliko milenijuma. Jedini izuzetak je *Agaricus bisporus* - šampinjon, koji se prvi put kao gajena vrsta pominje u 18. veku, i to na Evropskom tlu. Ova grana poljoprivrede dostiže veliku ekpanziju obezbedjujući intenzivnu proizvodnju veoma kvalitetne hrane na relativno malom prostoru i u uslovima koji ne zavise od spoljnih atmosferskih prilika. Medjutim, intenzivan uzgoj u uslovima gajilišta gljiva skopčan je sa brojnim rizicima, najčešće uzrokovanim: kompetitorskim ili parazitskim vrstama drugih gljiva, kvalitetom podloga za uzgoj, odabirom opreme u gajilištu i td. U traganju za eliminacijom i svodjenjem rizika na podnošljiv nivo, proizvodjači teže sve sofisticiranijoj opremi i novim sredstvima u borbi za sopstevne prinose. Proizvodnja biva sve intenzivnija, obimnija, i posledično još rizičnija. Ekofungi se okrenuo drugacijem putu i bazirao svoj rad na biološkim znanjima i temeljnom razumevanju prirodnih procesa. Prateći biološke karakteristike gajenih jestivih gljiva, zakonitosti u njihovom razvoju i tokovima životnog ciklusa, kreirali smo inovativnu tehnologiju proizvodnje *P.ostreatus* i *A. bisporus* po principima organske tehnologije. Primenjeni tehnološki procesi su isključivo simulacija procesa i tokova koji se dešavaju srodnim vrstama makromiceta u prirodi, adaptirani kontrolisanim uslovima u gajilištu.

Ekofungi danas primenjuje tehnologiju koja za 90% umanjuje troškove energenata u proizvodnji *P.ostreatus* i organizuje proizvodnju oko 130t organskih gajenih gljiva čitave godine u jedinstvenim objektima, posebno konstruisanim prema njihovim potrebama. Kvalitet proizvoda je uspešno proveren prema visokim zahtevima vrlo probirljivog trzista. Zahvaljujući ovome, u svetskoj mapi gljivarstva, prakse i nauke, stvorena je nova kategorija – Ekofungi proizvodjaca.

Sledeći naučnoistraživačke zaključke i biološka znanja, kreirali smo jedinstvenu i traženu tehnologiju koja proizvođačima obezbeđuje daleko profitabilniju proizvodnju organski gajenih jestivih gljiva.

Science and knowledge – tools in the production of high quality food

Ivanka Milenković
EKOFUNGI, doo, Beograd

The technology of mushroom cultivation is a few millennia old for all commercial species except one – *Agaricus bisporus*, also commonly known as the champignon. The cultivation of this species began in Europe in the 18th century, and since has gone through constant expansion due to its suitability for intensive and high quality production on a relatively small space, independent of external atmospheric conditions. However, there are many risks resulting from intensive indoor production: competitive or parasitic fungi species, substrate quality, choice of the production equipment, etc. In order to minimize the risks and increase the yield, producers are permanently seeking more sophisticated equipment and production methods. The result is that production is more intensive, with ever higher yields and, thus more risky. Ekofungi has taken a different approach, based on and driven by biological fundamentals and natural processes. Our innovative technology for the cultivation of *A. bisporus* and *Pleurotus ostreatus*, in line with organic production principles, was created based on a deep understanding of biological characteristics of edible fungi and their life cycle. The applied production processes simulate the natural behavior of macromycetes species, adapted for the indoor production.

Cultivation technology for *P. ostreatus* applied by Ekofungi reduces energy consumption by 90%. Using our innovative mushroom growing technology, we produce 130 t of organic edible mushrooms annually. Production is running year round, in production facilities constructed in the manner that provide the natural needs of these species. The quality of the products has been confirmed by an extremely demanding market. As a result of this, a new category has been created in the world map of mushroom science and practice: Ekofungi producers.

Based on the scientific research and knowledge, we have created a unique technology which provides more profitable production of organic edible mushrooms, highly required by producers all around the world.

POS2 / RTL2

Потстицање предузетничког начина размишљања код студената – Екотрофелија студентско такмчење

Виктор Недовић

Удружење прехрамбених технолога Србије

Пољопривредни факултет Универзитета у Београду

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Удружење прехрамбених технолога Србије почевши од 2013. године организује национално такмичење студентских тимова у креирању екоиновативних прехрамбених производа, ЕКОТРОФЕЛИЈА СРБИЈА. Задатак тимова је да осмисле нови производ који није присутан на тржишту, да га направе водећи рачуна о еколошком аспекту и упакају у адекватну амбалажуи да на самој амбалажи буду истакнути сви релевантни подаци у складу са национаалном легислативом. Такође тимови треба да припреме техничку документацију о производу, која укључује бизнис план, као и презентацију за само такмичење. Оцену студентских производа обавља експертски жири који је састављен од представника истраживачких институција, прехрамбене индустрије, дистрибуције и продаје. Најбоље оцењени тим и производ учествује на европској смотри која се под називом *EcoTrophelia Europe* одржава сваке године најчешће као једна од маинифестација највећих европских сајмова прехрамбених производа, *Sial* у Паризу и *Anuga* у Келну.

Такмичење има за циљ да промовише студентску иновативност, креативност и предузетнички дух, стварање нових екоиновативних производа базираних на сопственим идејама и пласман производа на националном и европском тржишту. Такође, такмичење утиче на подизање свести на универзитетима у смислу увођења нових предмета који се баве темом предузетништва, као и на подизање свести код студената у смислу покретања сопственог бизниса.

Encouraging of entrepreneurial way of thinking in the student's population – EcoTrohelia student's competition

Viktor Nedović

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Since 2013 Serbian Association of Food Technologists is organizing the national competition of student's teams in creation of eco-innovative food products titled EcoTrophelia Serbia. The students have the task to design the new food product that is not present on the market, to produce it on ecology friendly way and to pack it in adequate package which should have all relevant data according to national legislative. In addition to that the teams have to prepare the technical documentation about the product, including the business plan, as well as presentation about the product for the competition itself. The student's products are evaluated by the jury composed of experts from research institutions, food industry, distribution and retail network. The best assessed team and product represents the country at European competition called EcoTrophelia Europe that is annual event organized regularly as one of the happenings of the biggest European food fairs, Sial in Paris or Anuga in Cologne.

The competition itself has a goal to promote the student's innovation, creativity, entrepreneurial spirit, to promote the creation of new food eco-innovative products based on their own ideas, and placement of it on national or European market. In addition to that, the competition influences on awareness raising at universities in the sense of the development and introduction of new curricula on entrepreneurship and also awareness raising in the student's population in the sense of start their own business.

POS3 / RTL3

Nauka i privreda u Srbiji – mehanizmi stimulisanja saradnje

Mlađan Stojanović

Fond za inovacionu delatnost

Na povezivanje nauke i privrede se godinama unazad gleda kao na važan preduslov za efektivni razvoj ekonomije. Naučnoistraživački potencijal akademskog sektora u korist biznisa i na kraju društva u celini bi moglo da olakša prelaz sa ekonomije bazirane na tradicionalnim industrijama na industriju baziranu na znanju, koja daje proizvode i usluge sa visokom dodatom vrednošću. Odnedavno, svedoci smo stvaranja inovacionih ekosistema sa stimulativnim okruženjem za kreativne poduhvate, koji su pre svega motivisani tržišnom realnošću, a ne toliko razvojem tehnologije. Iako još u začetku, ovakve promene su vidljive i u Srbiji. U poslednjoj dekadi Srbija je napravila vidljiv napredak kako bi stimulisala inovacije kroz učešće u bilateralnim i multilateralnim inicijativama kao npr. učešće u evropskim naučnoistraživačkim okvirnim programima, ali takođe i kroz lokalne podsticaje za domaće inovatore. Od svog nastanka Fond za inovacionu delatnost realizuje nekoliko programa koji su specifično pripremljeni za dve ciljne grupe – sektor malih i srednjih preduzeća i naučnoistrživačke organizacije (NIO). Ovaj portfolio je pripremljen tako da pokrije inovacione projekte u ranoj fazi razvoja pa sve do projekata sa proizvodima spremnim za tržište. Vlada Republike Srbije je, kroz Fond dala finansisjki podsticaj na bazi kofinansiranja za više od 240 preduzeća i 40 akademskih institucija da se povežu i rade na stvaranju visokotehnoloških proizvoda iz svih oblasti tehnike. Ove aktivnosti su mobilisale sredstva u visini od preko 20 M€ i angažovale brojne NIO iz cele zemlje. Pripremljeni da budu konkurentni, ovi programi obezbeđuju sredstva za prelaz sa niskih nivoa tehnološke spremnosti do tržišta, preuzimajući veliki deo rizika od neuspeha, rizika koji je inherentan procesu stvaranja inovacija. Inovacioni ekosistem u Srbiji je još uvek u fazi razvoja i kako bi promene i uticaj na društvo postali vidljivi potrebna mu je podrška za dalji razvoj i rast.

Science and economy in Serbia – mechanisms for incentivizing cooperation

Mlađan Stojanović

Innovation fund

Connecting science and industry had been seen as one of the preconditions for effective development of countries' economies for years back. Utilizing potential of academia for the benefit of the business and ultimately the society at large could provide easier transition from an economy that is driven by traditional to industries that yield higher added-value products and services. Recently, we are witnessing creation of innovation ecosystems with stimulating environment for the creative works, driven even more than before not by the technology but the market reality. Although small in quantity, these developments can be observed in Serbia too. In the last decade, a notable effort has been made to stimulate innovation through engagement in bilateral and multilateral initiatives, such as participation in EU research framework programs, but also by offering local incentives for innovators in the country. Innovation fund, since its creation, is implementing programs specially designed for its target groups - private sector and academia. Its portfolio is designed to cover innovation projects ranging from early stage concepts to market-ready products. The Government, through Innovation fund has provided fiscal stimulus based on co-financing, to more than 240 local companies and 40 research organizations to connect and "co-create" high-technology products in all industrial areas. These activities engaged more than 20M€ in cash and mobilized R&D organizations across the country. Competitive in nature, these programs provide means for funding the transition from low technology readiness to the market, while sharing the risk of failure, the risk inherent to the process of creation. So far, the innovation ecosystem in Serbia is nascent in its current form, and needs to be supported further to allow its development and growth, necessary to make a notable change.

POS4 / RTL4

Evropska Agencija za bezbednost hrane/EFSA

Nadežda Dukić
DVM, EFSA kontakt tačka
Uprava za veterinu, Ministarstvo poljoprivrede, šumarstva i vodoprivrede
Evropska Agencija za bezbednost hrane

Tema je predstavljanje Evropske Agencije za bezbednost hrane: značaj i uloga, struktura i angažovanje, kao i nove e – naučne zajednice Knowledge Junction.
Evropska Agencija za bezbednost hrane /EFSA formirana je Uredbom o bezbednosti hrane (Regulation No 178/2002) sa zadatkom da obezbedi naučnu i tehničku podršku nadležnim organima EU u svim oblastima zakonodavstva, koje imaju direktan ili indirektan uticaj na bezbednost i kvalitet hrane.
EFSA preko svojih eksperata, pruža nezavisne informacije koje se tiču procene rizika u oblasti bezbednosti hrane i priprema mišljenja, kada joj Komisija EU, Parlament EU ili zemlje članice upute zahtev. Ova mišljenja dalje služe kao naučna osnova za izradu i usvajanje mera koje se sprovode u EU i na taj način doprinosi zdravlju ljudi, zdravlju i dobrobiti životinja, zdravlju bilja i zaštiti životne sredine. Komisija EU, EFSA i države članice blisko saradjuju što omogućava adekvatnu povezanost izmedju procene rizika, upravljanja rizikom i komunikacijama o riziku.
Rad Agencije je nazavisan i transparentan, a Agencijom rukovodi Upravni odbor koji se sastoji od 14 članova imenovanih od strane Saveta EU i direktor, Savetodavni forum, u radu učestvuju Naučni odbor i Naučni paneli (10 panela). EFSA se angažuje u prikupljanju podataka, konsultacijama, kolokvijumima, karijeri, stipendijama, javnim nabavkama, projektima, organizovanju veb konferencija.
EFSA je formirala novu zajednicu Knowledgw Junction na Zenodo platformi, koja je napravljena po uzoru na digitalnu biblioteku CERN Inventio. Sadržaji koji mogu uključivati skupove podataka, izveštaje, lab. analize, alate, modele i dr. koji potiču iz procene rizika u hrani i hrani za zivotinje, može se pregledati ili objaviti na ovoj platformi. Cilj je otvoren pristup naučnim modelima i alatima, ohrabruju se naučnici da deponuju svoje rezultate u korist šire zajednice koja se bavi procenom rizika, a povećaće naučne kapacitete i dodatno doprineti bezbednosti hrane u Evropi.

European Food Safety Agency/EFSA

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The topic is presentation about the European Food Safety Agency/EFSA-importance and role, structure and engagement, as well as the new e-science community-Knowledge Junction.
The European Food Safety Agency/EFSA was established by the Regulation No 178/2002 with the task to provide scientific and technical support to the competent EU authorities in all areas of legislation that have direct or indirect impact on food safety and quality.
EFSA through its experts, provides independant scientific opinions and advices in the risk assessment of food safety or when the EU Commision, the EU Parlament or the Member States make a request for it.
These opinions are used as the scientific basis for the development and adoption of measures implemented in the EU Member States which contribute to the health of people, animal health and welfare, the plant health and the protection of evironment. The EU Commission, EFSA and Member States work closely together which make a connection between risk assessment, risk management and risk communications.
The work of Agency is independant and transparent, and the Agency is managed by Management Board consisting of 14 members appointed by EU council and the Excusative Director, Advisory Forum, and the Scientific Committee and Scientific Panels (10 panels). EFSA engages in data collection, consulting, colloqua, career, folowship, procurements, grants, projects, organizing web conferences.
New e-community Knowledge Junction runs on the EU-funded Zenodo research-sharing platform. Zenodo is an open source product, built on the foundation of the CERN Invenio digital library. Content that may include datasets, reports, laboratory analysis, tools, models, etc. which arise from the risk assessment in food and feed, can be reviewed or published on this platform. The aim of the platform is open access to scientific models and tools. Also scientists are encouraged to insert their results for the benefit of the community that carries out risk assessment, and will increase scientific capacity and further contribute to food safety in Europe.

POS5 / RTL5

Inicijativa Globalne Harmonizacije (GHI)

Mirjana Pešić, GHI ambasador za Srbiju
Univerzitet u Beogradu, Poljoprivredni fakultet

Inicijativa Globalne Harmonizacije je međunarodna neprofitna mreža naučnih organizacije i naučnika koji zajedno rade kako bi promovisali usklađivanje propisa i zakona o bezbednosti hrane na svetskom nivou, postizanjem naučnog konsenzusa o ključnim pitanjima vezanim za bezbednost hrane a u cilju održavanja integriteta lanca snabdevanja hrane. GHI je osnovan 2004. godine kao dodatna aktivnost Instituta prehrambenih tehnologa (IFT) i Evropske federacije nauke o hrani i prehrambene tehnologije (EFFoST), a službeno postoji od 2007. godine. Potreba za osnivanjem GHI je rezultat činjenice da se svake godine uništava značajna količina zdravstveno bezbedne i nutritivno vredne hrane zbog različitih međudržavnih propisima koji se odnose na bezbednost hrane, što je neprihvatljivo znajući da jedna milijarda ljudi nema dovoljno hrane za jelo. Šta više, ove razlike utiču i na investiranje i implementaciju novih procesnih tehnolgija i tehnologjia konzervisanja hrane koje bi mogle povećati efikasnost proizvodnje hrane, smanjiti bezbednosne rizike vezane za hranu i povećati distributivni~~m~~ kapacitet svetskog tržišta.
Da bi postigli svoje ciljeve, GHI je osnovala nekoliko radnih grupa (WGs) koje se bave pitanjima vezanim za hemijsku bezbednost hrane, mikrobiologiju hrane, tehnologije konzervisanja hrane, edukaciju i trening ljudi koji rade sa hranom, zakone i propise vezane za hranu, nanotehnologiju i hranu, ishranu itd. pružajući naučno-zasnovane argumente za usklađivanje propisa i zakona o bezbednosti hrane i stimulišući istraživanja u onim oblastima gde nedostaju naučni rezultati. Kako bi distribuirali svoje rezultate što širem krugu ljudi, GHI je učestvovao na mnogim konferencijama, simpozijumima, seminarima, radionicama i drugim manifestacijama, objavio knjige i biltene. Štaviše, prvi GHI svetski kongres o bezbednosti i sigurosti hrane održaće se sledeće godine od 24 do 28 marta u Leiden-u, u Holandiji.

Global Harmonization Initiative (GHI)

Mirjana Pešić, GHI Ambassador for Serbia
University of Belgrade, Faculty of Agriculture

Global Harmonization Initiative (GHI) is an international non-profit network of scientific organizations and individual scientists working together to promote harmonization of global food safety regulations and legislation by achieving scientific consensus on key food safety matters with the aim of sustaining the integrity of the food supply chain. Founded in 2004 as a joint activity of the International Division of the Institute of Food Technologists (IFT) and the European Federation of Food Science and Technology (EFFoST), GHI was officially established in 2007. The need for GHI foundation is the fact that safe and nutrious food is destroyed every year due to differences in food safety regulations between countries which is unacceptable in an world in which one billion people suffer from under-nutrition. Moreover, these differences affect investments to and implementation of new processing and preservation technologies which can increase production efficiencies, reduce food hazard risks and improve distribution capabilities to global markets.
To reach its goals, GHI established several working groups (WGs) addressing issues such as chemical food safety, food microbiology, food preservation technologies, education and training of food handlers, food law and regulations, nanotechnology and foods, nutrition etc. giving science-based arguments for the harmonization of food safety regulations and legislation and to stimulate research for those issues where scientific support is lacking.
To disseminate its results, GHI has participated in many conferences, symposia, seminars, workshops and other meetings, published books and newsletters. Furthermore, 1st GHI world congress on food safety and security will be held next year, on 24-28 March in Leiden, the Netherlands.

Development of a natural anthocyanin-based food colorant obtained from the fruit epicarp of *Prunus spinosa* L.

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Prunus spinosa L. is a wild shrub with bitter and astringent fruits with poor commercial value. Nevertheless, they are rich sources of anthocyanins, more specifically cyanidin 3-rutinoside and peonidin 3-rutinoside, which are concentrated in the epicarp. These compounds possess recognized colouring properties and have been increasingly explored for substitution of artificial colorants, for being safer alternatives. In this context, the present work aimed to develop an anthocyanin-based food colorant obtained from *P. spinosa* fruit epicarp. The conditions that maximize the extraction were optimized, comparing heat (HAE) and ultrasound (UAE) assisted extraction techniques. For that purpose, a response surface methodology was applied, using a circumscribed central composite design with three variables and five levels, being the relevant variables time, temperature (HAE) or power (UAE), and ethanol concentration. The anthocyanin compounds were quantified by HPLC-DAD-ESI/MS. Furthermore, the bioactivity of the optimal extract was assessed through antioxidant, antimicrobial, and cytotoxic activity assays. UAE was the most efficient method, under optimal conditions of 5.0 ± 0.2 min, 400 ± 32 W, and 48 ± 3% ethanol, where the extraction yield was 68.60 ± 2.1%, with a total anthocyanin content of 18 ± 2 mg/g (dried extracted residue-basis) and 11,8 ± 0,8 mg/g (dried epicarp-basis). Additionally, these response values were slightly improved when the solid-to-liquid ratio effect at the optimal conditions in a dose-response format was tested, showing a steady decreasing pattern in the range of 5 to 250 g/L. Regarding bioactive properties, the obtained extract presented antioxidant activity, with EC_{50} values of 204.22 ± 0.02 µg/mL for the TBARS assay and 296 ± 4 and 509 ± 3 µg/mL for OxHLIA method at 60 and 120 min of reaction, respectively; and antimicrobial properties, allowing the growth inhibition of 9 bacteria strains of public health interest in concentrations from 2.5 to 20 mg/mL. Besides, the obtained extract did not show hepatotoxic effects on a porcine liver primary cell culture (PLP2), being thus safe for incorporation into foodstuff. Lastly, the anthocyanin-based extract was introduced in a traditional Brazilian confectionary product, “beijinho”, where its colouring capacity was confirmed.

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HZ2 / FH2 U/O

Polifenol vina, rezveratrol širi renalnu arteriju dijabetičnog pacova aktivacijom vaskularnih kalijumovih kanala

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Rezveratrol, *trans*-3,5,4'-trihidroksi stilben je prirodni fitoaleksin prisutan u namirnicama koje svakodnevno unosimo. Najvažniji izvor rezveratrola je crveno vino. Izgleda da je rezveratrol odgovoran za poznati epidemiloški fenomen "Francuski paradoks" (nizak kardiovaskularni mortalitet kod ljudi koji su imali faktore rizika, ali su konzumiralni crveno vino na dnevnoj bazi). Rezveratrol ima povoljna kardiovaskularna dejstva. On uzrokuje širenje krvnih sudova čoveka i životinja. Mehanizam vazodilatacije prouzrokovane rezveratrolom nije dovoljno ispitan. Zato je cilj ove studije ispitivanje efekta rezveratrola na izolovanoj renalnoj arteriji (RA) pacova kome je aloksanom indukovan dijabetes i uloge vaskularnih kalijumovih kanala u ovoj relaksaciji. Rezultati nasih eksperimenata pokazuju da rezveratrol širi RA, ali dijabetes smanjuje osetljivost RA na rezveratrol. Rezultati ispitivanja afiniteta selektivnih blokatora kalijumovih kanala, ukazuju da su različiti podtipovi vaskularnih kalijumovih kanala uključeni u mehanizam dejstva rezveratrola na zdravoj RA, a samo voltažno-senzitivni kalijumovi kanali (Kv1.x) učestvuju u efektu rezveratrola na RA pacova sa dijabetesom. Dijabetes je prouzrokovao endotelnu disfunkciju RA sa smanjenom ekspresijom svih kalijumovih kanala, sa izuzetkom Kv1.3 kanala. Renalna arterija je posebno važna za regulaciju bubrežne cirkulacije i opštih kardiovaskularnih funkcija. Rezultati nasih ispitivanja ukazuju da rezveratrol ima renovaskularne protektivne efekte na krvnom sudu pacova sa dijebetesom.

Wine polyphenol, resveratrol produses relaxation of isolated renal artery of diabetic rats by activation of vascular potassium channels

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Resveratrol, *trans*-3,5,4'-trihydroxy stilbene is a naturally occurring phytoalexin present in many different types of nutrients which we consume on daily basis. The main source of resveratrol is red wine. It plays the most important role in the epidemiological phenomenon called "French paradox" (existence of cardiovascular risk factors with low incidence/mortality rates which may attribute to moderate consumption of red wine). Resveratrol has beneficial cardiovascular effects. It relaxes different human and animal blood vessels. Mechanism of vasodilatation by resveratrol is not well defined. Therefore, the aims of the present study were to find out how alloxan-induced diabetes alters the response of the precontracted rat renal artery (RA) to resveratrol, and to examine the role of potassium channels in the vascular action of resveratrol. Resveratrol produced relaxation of RA, but diabetes reduced the sensitivity to resveratrol in RA. According to potassium channel blockers affinity, it seems that different subtype of potassium channels are involved in the resveratrol-induced relaxation of RA of normal rats and only voltage-sensitive potassium (Kv1.x) channels took a part in the resveratrol effect on the RA of diabetic rats. Endothelial dysfunction developed during diabetes leads to down-regulation of expression of almost all tested potassium channels, while up-regulation of Kv1.3 channel expression has been observed. The renal artery is particularly important due to its role in regulation of cardiovascular and renal function and these results suggest the renovascular protective effect of resveratrol in diabetes.

HZ3 / FH3 U/O

Dijetarni antocijani i njihovi metaboliti snižavaju adheziju i dijapedezu monocita preko mehanizama koji regulišu permeabilnost endotelnih ćelija

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Kardioprotektivno dejstvo antocijana, fitohemikalija prisutnih u bobičastom voću, se delom pripisuje njihovom povoljnom uticaju na endotelnu funkciju. Ipak, tačni mehanizmi delovanja nisu u potpunosti jasni. Cilj ove studije je bio da ispita uticaj antocijana i njihovih metabolita na funkciju endotelnih ćelija i identifikuje molekularne mehanizme delovanja uz pomoć „omics“ pristupa.
Endotelne ćelije su tretirane smešom delfinidin-3-glukozida, peonidin-3-glukozida, cijanidin-3-glukozida, cijanidin-3-galaktozida, cijanidin-3-arabinozida i metabolita 4-hidroksibenzaldehida, ili smešom vanilinske, protokatehuinske, hipurne i ferulinske kiseline, u fiziološki relevantnim koncentracijama. Inflamacija je indukovana i monociti dodavani u cilju praćenja njihove adhezije i transmigracije. Analizirani su ekspresija gena i mikro-RNK, molekulski doking i fosforilacija signalnih proteina.
Antocijani i njihovih metaboliti doveli su do smanjenja adhezije i transendotelne migracije monocita. Analiza genske ekspresije pokazala je promenu u ekspresiji gena uključenih u regulaciju adhezije ćelija, reorganizacije citoskeleta i fokalne adhezije. Bioinformatička analiza rezultata genske ekspresije otkrila je transkripcione faktore koji bi mogli doprineti uočenom dejstvu ovih jedinjenja na ekspresiju gena, i signalne proteine koji regulišu njihovu aktivnost. Molekulski doking je omogućio da se otkriju signalni proteini za koje ispitivana jedinjenja mogu da se vežu i time potencijalno utiču na njihovu aktivnost i aktivaciju nizvodnih signalnih puteva. Predviđeno delovanje ovih jedinjenja na signalne puteve potvrđeno je i imunobloting analizom. Ispitivana jedinjenja su uticala i na ekspresiju mikro-RNK, posebno onih uključenih u regulaciju permeabilnosti endotelnih ćelija, doprinoseći uočenim promenama endotelne funkcije.
Rezultati ove studije su pokazali pozitivno delovanje antocijana i njihovih metabolita na funkciju endotelinih ćelija i pružili nova saznanja o mehanizmima njihovog delovanja.

Dietary anthocyanins and their metabolites lower monocyte adhesion and diapedesis through mechanisms that regulate endothelial cell permeability

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Cardioprotective effects of anthocyanins, phytochemicals present in berries, are partly attributed to their ability to improve endothelial function. Still, the underlying mechanisms are not fully understood. This study aimed to examine the effect of anthocyanins and their metabolites on endothelial cell function and decipher underlying molecular mechanisms using omics approaches.
Primary endothelial cells were exposed to a mixture of delphinidin-3-glucoside, peonidin-3-glucoside, cyanidin-3-glucoside, cyanidin-3-galactoside, cyanidin-3-arabinoside and metabolite 4-hydroxybenzaldehyde or a mixture of vanillic acid, protocatechuic, hippuric and ferulic acid at physiologically relevant concentrations. Inflammation was induced and monocytes added to assess adhesion and transmigration. Gene and miRNA expression, molecular docking and cell-signalling protein phosphorylation were examined.
Anthocyanins and their metabolites reduced monocyte adhesion and transendothelial migration. Transcriptomic analysis showed that these compounds modulated the expression of genes involved in the regulation of cell-cell adhesion, cytoskeleton organisation or focal adhesion. Bioinformatics analyses of gene expression data identified potential transcription factors involved in the observed nutrigenomic effect and signalling proteins regulating their activity. Molecular docking revealed cell-signalling proteins to which these bioactives may bind to and potentially affect their activity and activation of downstream signalling proteins and transcription factors, the effects in agreement with the results of Western blot analysis. Tested compounds also modulated the expression of microRNAs, especially those involved in regulation of endothelial permeability, contributing to the observed changes in endothelial function.
Results of this study showed endothelial-protective properties of anthocyanins and their metabolites and deciphered underlying multi-target and multi-layered mode of action.

HZ4 / FH4 U/O

Uklanjanje alkohola crvenom vinu čini ga korisnim napitakom za obolele od hipertenzije

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U kardiovaskularnim bolestima, povišen pulsni pritisak (PP) predstavlja nezavisan faktor rizika za lošu prognozu ishoda bolesti. U esencijalnoj hipertenziji inverzno koreliše sa niskim nivoom magnezijuma detektovanog u plazmi. Kako polifenolna jedinjenja iz vina ispoljavaju blagotvorno dejstvo u brojnim hroničnim oboljenjima uključujući i hipertenziju, cilj ove studije bio je da ispita efekte uklanjanja alkohola iz vina Prokupac na njegov polifenolni sastav i uticaj dealkoholizacije na PP i nivo magnezijuma u spontano hipertenzivnih pacova (SHR). HPLC-DAD analizama su kvantifikovani antocijani i polifenoli različiti od antocijana zastupljenih u predmetnom vinu. U in vivo studiji, SHR kontrola je dobijala česmenu vodu, a druge dve grupe su dobijale vino ili vino kome je uklonjen alkohol (AFW) gavažom, tokom 4 nedelje eksperimenta. Anesteziranim životinjama meren je krvni pritisak direktnom metodom, preko katetera plasiranog u femoralnu arteriju povezanog sa uredjajem Cardiomax III. Biohemijski parametri u uzorcima krvi odredjivani su pomoću automatskog analizatora. Uklanjanje alkohola statistički značajno je povećalo prisustvo nekih, ali ne svih komponenti vina. Najzastupljeniji antocijan u ovom vinu bio je malvidin-3-O-glukozid, dok su druga polifenolna jedinjenja kao što su elagna kiselina, resveratrol ili kvercitrin bila prisutna u znatno nižim koncentracijama. Hronični unos AFW značajno je smanjio srednji arterijski krvni pritisak i eliminisao štetne efekte alkohola na PP SHR. Obe vrste vina su povećale koncentraciju magnezijuma u plazmi (koji se može ponašati kao mimetik kalcijum antagonista), ali samo u AFW grupi je ovo povećanje nivoa magnezijuma pratilo i značajno smanjenje PP i srednjeg arterijskog pritiska. Uklanjanje alkohola iz vina eliminiše PP, važan faktor rizika za nastanak kardiovaskulaskularnih komplikacija, promovišući AFW kao korisan napitak kod hipertenzivnih subjekata.

Dealcoholized red wine as a useful beverage of hypertensive subjects

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Increased pulse pressure (PP) is an independent risk factor for poor outcome in cardiovascular disease, and inversely correlates with low plasma magnesium values in essentially hypertensive patients. Polyphenolic compounds from wine showed beneficial effects in numerous chronic diseases including hypertension. The present study examines the effects of the removal of alcohol from the wine Prokupac to its polyphenolic composition, as well as their influence on PP and magnesium level in spontaneously hypertensive rats (SHR). HPLC-DAD analysis of Prokupac wine anthocyanin and non-anthocyanin compounds were performed. In the in vivo part of the study SHR were divided in 3 groups: control SHR received tap water, while other two groups received 1ml/day wine or alcohol-free wine (AFW) by gavage, throughout the 4-week experimental period. Blood pressure was measured in anesthetized rats directly through a femoral artery catheter connected to physiological data acquisition system (Cardiomax III). Blood samples were collected and biochemical parameters were measured using an automatic Cobas integra 400 plus analyzer. The dealcoholization process increases the concentrations of some but not all individual red wine components. The most abundant anthocyanin in this wine was malvidin-3-O-glucoside, while other polyphenolic compounds such as ellagic acid, resveratrol or quercitrin were present in much lower concentrations. Chronic intake of AFW significantly reduced mean arterial blood pressure and eliminates adverse effects of alcohol on PP in SHR. Consumption of both types of wine increased plasma magnesium concentration (could mimic calcium channel antagonists), but only in the AFW group it was followed with the significant reduction of mean and PP. Removing alcohol from wine eliminates cardiovascular risks, and promotes AFW as a useful beverage in hypertensive subjects.

HZ5 / FH5 U/O

Prirodni polifenoli, rezveratrol i naringenin, inhibiraju patološke kontrakcije miometrijuma

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Prirodni polifenoli prisutni su u velikom broju biljnih vrsta. Posebni izvori resveratrola su grožđe i crveno vino, a naringenina grejpfrut, njegov sok, hmelj i pivo. Tokom poslednje decenije, resveratrol je u fokusu naučnog i opšteg interesovanja kao supstanca koja ima anti-tumorska, antiinflamatorna, kardio-zaštitna svojstva. U proteklih deset godina, resveratrol se nalazi u centru pažnje kao "jedan molekul - mnogo meta". Naringenin pripada flavonoidima. Efekti naringenina nisu istraženi. Patološka kontraktilnost uterusa uzrokuje značajne poremećaje kao što su spontani pobačaj, preterminski porođaj, neplodnost. Ciljevi ove studije bili su istraživanje mogućeg inhibitornog efekta polifenola u nekoliko eksperimentalnih modela kontrakcija gravidne i negravidne materice.
Životinje koje su korišćene u eksperimentima bile su ženske *Wistar* pacova. Humani uzorci miometrijuma dobijeni su od pacijentkinja u 37-39 nedelje gestacije tokom porođaja operacijom. Uzorci su montirani u organska kupatila za izolovane organe i merena je izometrijska tenzija. Resveratrol i naringenin su kumulativno dodavani u kupatilo za izolovane organe. Uticaji polifenola ispitani su na spontanim ritmičkim kontrakcijama, faznim i toničnim kontrakcijama indukovanim oksitocinom.
Rezultati pokazuju da resveratrol izaziva snažne inhibitorne efekte na spontane i indukovane kontrakcije životinjske i ljudke materice. Naringenin koncentracijski- zavisno inhibira sve modele kontrakcija. Srednja efektivna koncentracija naringenina bila je slična za sve modele kontrakcija, što sa resveratrolom nije bio slučaj. Resveratrol je pokazao statistički značajno veću potentnost od naringenina na svim modelima kontrakcija.
U zaključku može se reći da je pokazano da resveratrol i naringenin imaju veliki potencijal da se koriste u prevenciji i lečenju abnormalne i neželjene kontraktilnosti uterusa, kao što je slučaj sa dismenorejom i prvremenim porođajem.

Natural polyphenols, rezveratrol and naringenin, inhibit pathological contractions of the myometrium

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Natural polyphenols are present in the large number of plant species. As special sources of resveratrol are grapes and red wine, and sources of naringenin are grapefruit, its juice, hop and beer. It has been shown that resveratrol possess anti-cancer, anti-inflammatory, cardio-protective properties. Resveratrol is found in the focus of scientific and public interest as a substance like “one molecule-many targets”. The effects of naringenin have not been investigated. The abnormal contractility of myometrium cause important disorders such as spontaneous miscarriage or preterm birth, implantation failure, infertility. The aims of this study were to investigate the possible inhibitory effect of polyphenols in several experimental models of contractions of pregnant and non-pregnant uterus.
The animals used in the experiments were virgin female Wistar rats. Myometrial samples were obtained from nonlaboring women (37–39 weeks gestation) undergoing elective cesarean sections. Samples were mounted into the bath for isolated organs for recording isometric tension. Resveratrol and naringenin were added cumulatively to the bath for isolated organs. The effects of polyphenols were investigated on the spontaneous rhythmic contractions, oxytocin-induced phasic and tonic contractions.
The results show that resveratrol exerts potent inhibitory effect on the spontaneous and induced contractions of non-pregnant rat uterus and human pregnant uterus. Naringenin in concentration dependent manner inhibited contraction of animal and human uterus, too. Mean effective concentrations of naringenin were similar for all models, which was not the case by the resveratrol. Resveratrol showed statistically significantly higher potency of naringenin on all models of contractions.
In conclusion, we have shown that resveratrol and naringenin have great potential to be used in the prevention and treatment of abnormal and undesirable uterine contractility, as in the case of dysmenorrhea and premature births.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZ6 / FH6 U/O

Mehanizam vazorelaksacije humane unutrašnje mamilarne arterije izazvane epikatehinom

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Epidemiološke studije su pokazale da je redovna upotreba hrane i pića bogatih flavanolima, kao što su kakao, jabuke, crveno grožđe i crveno vino, povezana sa smanjenim rizikom od kardiovaskularnih bolesti. Kardioprotektivni efekat epikatehina, kao glavnog aktivnog sastojka hrane bogate flavanolima, delom se može pripisati njegovom vazodilatatornom, antioksidativnom, antiproliferativnom i antiagregacionom dejstvu. Tačni mehanizmi kojima epikatehin izaziva vazodilataciju još uvek nisu razjašnjeni.
Ova studija imala je za cilj ispitivanje vazorelaksantnog dejstva epikatehina na izolovanoj unutrašnjoj mamilarnoj arteriji (HIMA) i definisanje mehanizama ove relaksacije.
Segmenti HIMA uzimani su od pacijenata tokom bajpas operacija i ispitivani u vodenom kupatilu.
Epikatehin je izazvao koncentracijski-zavisnu relaksaciju HIMA prekontrahovane fenilefrinom. 4-Aminopiridin i margatoksin, blokatori K_V kanala, i glibenklamid, blokator K_{ATP} kanala, delimično su inhibirali epikatehinom izazvanu relaksaciju HIMA, dok je iberiotoksin, selektivni blokator BK_{Ca}, potpuno blokirao relaksaciju. Epikatehin je delimično relaksirao HIMA kontrahovanu dodatkom 80 mM K^+, ali je izazvao punu relaksaciju arterijskih prstenova kontrahovanih fenilefrinom i kofeinom u medijumu bez Ca^{2+}. Tapsigargin, inhibitor Ca^{2+}-ATPaze sarkoplazmatskog retikuluma, blago je inhibirao relaksaciju HIMA kontrahovane fenilefrinom.
Ovi rezultati pokazuju da epikatehin izaziva snažnu endotel-nezavisnu relaksaciju HIMA kontrahovane fenilefrinom. U mehanizam ove relaksacije uključeni su 4-aminopiridin- i margatoksin-senzitivni K_V kanali, kao i BK_{Ca} i K_{ATP} kanali. Osim toga, izgleda da epikatehin može da inhibira ulazak ekstraćelijskog Ca^{2+}, ali i da utiče na oslobađanje intraćelijskog Ca^{2+} i njegovo ponovno preuzamanje u sarkoplazmatski retikulum.

Mechanism underlying the vasorelaxation of human internal mammary artery induced by epicatechin

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Epidemiological studies have provided evidence that the regular consumption of flavanol-rich foods and beverages, such as cocoa, apples, red grapes and red vine, is associated with reduced risk of cardiovascular diseases. Cardioprotective effects of epicatechin, as the main bioactive constituent of flavanol-rich food, might be attributed, in part, to its vasodilatory, antioxidant, antiproliferative and anti-aggregation effect. The exact mechanisms by which epicatechin causes vasodilation are still unclear.
The present study aimed to investigate relaxant effect of epicatechin on the isolated human internal mammary artery (HIMA) and its underlying mechanisms.
The HIMA segments were collected from patients undergoing coronary artery bypass grafting and studied in organ baths.
Epicatechin induced a concentration-dependent relaxation of HIMA pre-contracted by phenylephrine. Four-aminopyridine and margatoxin, blockers of K_V channels, and glibenclamide, a selective K_{ATP} channels blocker, partly inhibited the epicatechin-induced relaxation of HIMA, while iberiotoxin, a most selective blocker of BK_{Ca}, abolished the relaxation. Epicatechin partially relaxed HIMA pre-contracted by 80 mM K^+, while induced complete relaxation of rings pre-contracted by phenylephrine and caffeine in Ca^{2+}-free medium. Thapsigargin, a sarcoplasmic reticulum Ca^{2+}-ATPase inhibitor, slightly antagonized epicatechin-induced relaxation of HIMA pre-contracted by phenylephrine.
These results suggest that epicatechin induces strong endothelium-independent relaxation of HIMA pre-contracted by phenylephrine whilst 4-aminopyridine- and margatoxin-sensitive K_V channels, as well as BK_{Ca} and K_{ATP} channels, mediate this relaxation. In addition, it seems that epicatechin could inhibit influx of extracellular Ca^{2+}, interfere with intracellular Ca^{2+} release and re-uptake by the sarcoplasmic reticulum.

HZ7 / FH7 U/O

Dohrana ekstraktom lista masline, *Olea europaea* L., poboljšava oksidativni status i lipidni profil u eksperimentalnoj hroničnoj bubrežnoj bolesti

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Oksidativni stres, udružen sa hiperlipidemijom, ima važnu ulogu u progresiji fokalno segmentne glomerulosleroze (FSGS). Ekstrakt lista masline-OLE bogat je fenolnim jedinjenjima koja poseduju antioksidativna i antihiperlipemična svojstva. U ovom istraživanju ispitivali smo efekte hronične primene OLE na oksidativni stres i lipidni profil kod spontano hipertenzivnih pacova (SHR, starosti 24-nedelje) sa eksperimentalno izazvanom FSGS. Ženke kontrolne grupe (CON) su primile fiziološki rastvor, dok su pacovi u grupama FSGS i FSGS+OLE primili adrijamicin (2 mg/kg telesne mase *i.v.*) dva puta u intervalu od 3 nedelje. Zatim su pacovi u grupi FSGS+OLE dobijali OLE 80 mg/kg/dan gavažom tokom 6 nedelja. Analizirani su lipidni status, aktivnosti SOD-superoksid dismutaze, CAT-katalaze i GP_x-glutation peroksidaze u eritrocitima i lipidna peroksidacija u plazmi eksperimentalnih životinja. Koncentracija ukupnog holesterola, LDL-holesterola i triglicerida bile su značajno povećane u plazmi pacova FSGS grupe (p<0,001) u poređenju sa kontrolnim životinjama. U grupi FSGS+OLE vrednosti ovih parametara bile su značajno smanjene u poređenju sa FSGS grupom, tako da se nisu značajno razlikovale od vrednosti u kontrolnoj grupi. Aktivnosti antioksidativnih enzima u eritrocitima pacova FSGS grupe bile su slične aktivnostima izmerenim u kontrolnoj grupi. U eritrocitima pacova FSGS+OLE grupe OLE tretman značajno je povećao aktivnosti SOD i GP_x u poređenju sa vrednostima izmerenim u FSGS i kontrolnoj grupi. U poređenju sa kontrolnom grupom, lipidna peroksidacija u plazmi značajno je povećana kod pacova FSGS grupe (p<0,01). OLE tretman značajno je smanjio lipidnu peroksidaciju plazme (p<0,001) u poređenju sa FSGS grupom, a do nivoa kao u kontrolnoj grupi.
Šestonedeljna primena ekstrakta lista masline u ishrani SHR sa FSGS dovela je do poboljšanja oksidativnog i lipidnog statusa što predstavlja dobar osnov za usporavanje progresije hronične bubrežne bolesti.

Consumption of *Olea europaea* L. leaf extract improves oxidative status and lipid profile in experimental chronic kidney disease

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Oxidative stress plays an important role in the development and progression of focal segmental glomerulosclerosis (FSGS). Hyperlipidemia is commonly present in FSGS. *Olea europaea* L. leaves are rich in phenolic compounds that are known to possess antioxidant and antihypercholesterolemic properties. In this study we investigated the effects of chronic *Olea europaea* L. leaf extract (OLE) treatment on oxidative stress and lipid profile in spontaneously hypertensive rats (SHR) with experimental FSGS. Females SHR (24-week-old) were divided in three groups. Control rats (CON) received vehicle, while FSGS, FSGS+OLE groups received adriamycin (2 mg/kg body weight *i.v.*) twice in 3-week-interval. After the second injection, FSGS+OLE received OLE 80 mg/kg/day by gavage for 6 weeks. Lipid status in plasma, antioxidant enzymes activities (SOD-superoxide dismutase, CAT-catalase, and GPx-glutathione peroxidase) in erythrocytes, and plasma lipid peroxidation were analyzed. Plasma total cholesterol, LDL-cholesterol and triglicerides were significantly increased in FSGS group (p<0.001) compared to control. In FSGS+OLE group OLE treatment significantly reduced these values compared to FSGS group, to the level not significantly different from control. Antioxidant enzymes activities in erythrocytes in FSGS group were similar to the control group. SOD and GPx activities in erythrocytes were significantly increased in FSGS+OLE group compared to FSGS and control group. Plasma lipid peroxidation was significantly increased in FSGS group (p<0.01) compared to control. OLE treatment significantly decreased plasma lipid peroxidation (p<0.001) compared to FSGS, to the level as in control group.
Chronic consumption of *Olea europaea* L. leaf extract in SHR with FSGS improves oxidative status and lowers plasma triglycerides and high cholesterol, presenting a good basis for slowing down the progression of chronic kidney disease.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZ8 / FH8 U/O

Povezanost otpora u karotidnoj arteriji i endogene antioksidativne odbrane sa arterijskim pritiskom nakon unosa majkine dušice, u hipertenziji i normotenziji

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Prethodne studije su pokazale pozitivnu korelaciju rizika za nastanak kardiovaskularnih bolesti (i dijametra arterija) sa visokim krvnim pritiskom (KP). Mi smo nedavno prikazali negativnu povezanost aktivnosti enzima hem oksigenaze-1 i ukupnog vaskularnog otpora sa srednjim KP kod hipertenzivnih, ali ne i normotenzivnih pacova, tretiranih vodenim ekstraktom majkine dušice (MD, *Thymus serpyllum* L.). U ovoj studiji smo analizirali uticaj akutne primene MD na karotidnu hemodinamiku (karotidni: protok krvi-KPK i otpor-KO) i korelirali te parametre sa endogenom antioksidativnom odbranom pacova sa urođenom hipertenzijom (HP), kao i pacova sa normotenzijom (NP). Kontrolni HP i NP su dobijali fiziološki rastvor (FR), dok su MDHP I MDNP dobijali MD u FR (100mg/kg i.v.) KPK je meren anesteziranim pacovima, postavljanjem ultrazvučne sonde oko arterije, uz kontinuirano praćenje KP na Cardiomax III uređaju, dok je KO izračunavan deljenjem KP sa KPK. U uzorcima krvi je određivan bilirubin, kao i aktivnosti superoksid dismutase, katalaze i glutation peroksidaze u eritrocitima. MD je smanjila KPK i povećala bilirubin u plazmi NP, bez da je imala uticaj na KO, srednji KP ili antioksidativne enzime. HP su imali povećan KO u poređenju sa NP ($p<0.001$), što je bilo u pozitivnoj korelaciji sa KP ($r=0.8825$; $p<0.001$). Nakon tretmana MD, KO je bio značajno smanjen kod HP ($p<0.05$). Aktivnost glutation peroksidaze je bila smanjena kod HP u poređenju sa NP. Tretman MD to nije promenio, niti je uticao na superoksid dismutazu, ali je 3 puta povećao katalaznu aktivnost. Kod netretiranih i MD tretiranih HP, korelacija između KO i KP je bila: $r=0.7061$; $p=0.01$, dok su korelacije katalazne aktivnosti i bilirubina sa srednjim KP bile $r= - 0.6178$; i $r= - 0.9249$; $p=0.000$.Prikazani rezultati promovišu MD kao vazorelaksantnu biljku, sposobnu da normalizuje hemodinaske parametre u karotidnoj arteriji.

Correlation of resistance in the carotid atrery and endogenous antioxidant defence with arterial pressure in responce to wild thyme: hypertension versus normotension

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Previous studies have shown association between cardiovascular disease risk factors and carotid artery diameter which is positively correlated with high blood pressure (BP). Recently, we shown marked negative correlation between heme oxigenase-1 enzyme activity and mean BP, as well as total vascular resistance in hypertensive, but not normotensive rats treated with aqueous extract from wild thyme (WT, *Thymus serpyllum* L.). Here we analyzed the effects of acute WT application on carotid haemodynamics (carotid blood flow-CBF, carotid vascular resistance-CVR) and correlation of these parameters with endogenous antioxidant defense of spontaneously hypertensive rats (SHR) and normotensive *Wistar* (WR) counterparts. Control SHR and WR received vehicle, and SHRWT and WRWT received WT (100mg/kg i.v.).CBF was measured in anesthetized rats by placing an ultrasound probe around artery with continuous registration of mean BP on Cardiomax III, while CVR was calculated by devoting MBP and CBF. Blood samples were collected for the determination of plasma bilirubin concentration, and erythrocytes activity of superoxide dismutase, catalase and glutathione peroxidase. WT reduced CBF and elevates plasma bilirubin in WR, without affecting CVR, mean BP or antioxidant enzymes. SHR showed increased CVR compared to WR ($p<0.001$)which was in positive correlation to mean BP ($r=0.8825$, $p<0.001$), and became significantly reduced after WT in hypertensive rats ($p<0.05$).Glutathione peroxidase activity was reduced in SHR vs. WR. In SHRWT it did not change, but catalase increased up to 3 fold, while superoxide dismutase remained as in SHR group. In SHR (vehicle and WT treated) the correlation between CVR and mean BP was $r=0.7061$ with $p=0.01$, while correlations between catalase, and plasma bilirubin vs. mean BP were $r=-0.6178$ with $p=0.032$, and $r=- 0.9249$ with $p=0.000$.These results promote WT as a vasorelaxant herb capable to normalized carotid artery haemodynamics.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZ9/ FH9 U/O

Efekat ekstrakta lista masline (*Olea europaea* L.)u odnosu na oleuropein u eksperimentalnoj hipertenziji

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Ekstrakt lista masline-OLE (*Olea europaea* L.) je bogat flavonoidima, oleuropeozidima i zasićenim fenolima. Njegova antioksidativna svojstva, koja vode do sniženja lipidne peroksidacije u krvi i organima, pripisuju se visokom sadržaju (~20%) oleuropeina (OP) i njegovog derivata hidroksitirozola. Pored antioksidativnog potencijala ova jedinjenja pokazuju, kako antihipertenzivna svojstva, tako i sposobnost snižavanja holesterola u krvi. Cilj ove studije je bio da ispita doprinos OP (10mg/kg) efektima OLE (50mg/kg) na hemodinamske parametre (krvni pritisak, srčanu funkciju), lipidni status i oksidativni stres kod pacova sa urođenom hipertenzijom (SHR). Koristili smo 24 nedelje stare, muške pacove podeljene u tri eksperimentalne grupe. Hemodinamski parametri su mereni pre i posle intravenskog tretmana sa fiziološkim rastvorom, OLE ili OP. Uzorci krvi su sakupljani nakon hemodinamskih merenja. Sistolni, dijastolni, pulsni i srednji krvni pritisak, kao i minutni volumen srca, normalizovani su nakon akutnog tretmana OLE50, ali ne i sa OP10. Dolazi do značajnog sniženja lipidne peroksidacije u obe tretirane grupe (OLE50 i OP10) u poređenju sa kontrolnom grupom SHR. Nije bilo razlike u nivou triglicerida između kontrolne grupe i grupe OLE50, dok je tretman oleuropeinom značajno snizio trigliceride u odnosu na kontrolnu grupu ($p < 0.001$), kao i u poređenju sa grupom OLE50 ($p<0.001$). Glavni činilac ovog standardizovanog ekstrakta, OP, ne utiče na sistemsku hemodinamiku, ukazujući da su druge komponente ovog ekstrakta odgovorne za promene u srčanoj funkciji kod SHR, dok antioksidativni potencijal OP, kao i njegova sposobnost da poboljša lipidni profil su doprinos OP u kardioprotektivnim svojstvima ovog ekstrakta

Effects of *Olea europaea* L. leaf extract versus oleuropein in experimental hypertension

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Olea europaea L. leaf extract (OLE) is reach in flavonoids, oleuropeosides and substituted phenols. Its antioxidant properties that lead to reduction of lipid peroxide accumulation in blood and other target organs, have been attributed to the high content (~20%) of oleuropein (OP) and its derivative hydroxytyrosol. Beside this antioxidative potential, these compounds showed antihypertensive and hypocholesterolemic properties. The aim of the present study was to evaluate the contribution of OP (10mg/kg) to the effects of the OLE (50mg/kg) on haemodynamic parameters (blood pressure, cardiac performances), lipid status and oxidative stress in spontaneously hypertensive rats (SHR). We used 24 weeks old male spontaneously hypertensive rats (SHR), divided into three experimental groups. Haemodynamic parameters were measured in anesthetized rats before and after i.v. saline, OLE or OP treatment, and blood samples were collected after haemodynamic measurements. Systolic, diastolic, pulse and mean blood pressure, as well as cardiac output was normalized after the administration of OLE50, but not OP10. There was a significant reduction of plasma lipid peroxidation in both, OLE50 and OP10 compared to control SHR. There was no difference in triglyceride levels between the control group and the group OLE50, while OP10 showed significantly lower levels of triglycerides in plasma compared to the control group ($p < 0.001$), as well as compared to OLE50 group ($p<0.001$).The main constituent of this standardized extract, OP, do not affect systemic haemodynamics, indicating that other components of OLE are responsible for changes of cardiac function in SHR. The antioxidative potential, but also the ability of OP to improve the lipid profile enables it to act as cardioprotectant.

HZ10 / FH10 U/O

Efekti primene *Lactobacillus rhamnosus* LA68 na sastav masnih kiselina organa u uslovima standardne i ishrane sa visokim sadržajem masti- studija na životinjama

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U literaturi postoje podaci koji ukazuju da primena određenih bakterija mlečne kiseline, a među njima i laktobacila, utiče na masnokiselinski sastav organa kao što su jetra, mozak i adipozno tkivo, a primećena je i razlika u ispoljenom efektu u odnosu na primenjeni soj. Cilj ove studije je bio da se ispita efekat određenog soja laktobacila, *L. rhamnosus* LA68, na sastav masnih kiselina jetre i mozga kako u uslovima standardne ishrane, tako i uslovima ishrane sa visokim sadržajem masti (VSM) kod miševa soja C57BL/6. Rezultati određivanja sastava masnih kiselina u ukupnim lipidima jetre nakon standardne ishrane pokazuju da je primena *L. rhamnosus* LA68 tokom 4 nedelje pokazuju statistički značajno povećanje sadržaja palmitoleinske kiseline (1,36±0,24% vs 0,92±0,28%, p<0,05) u odnosu na kontrolnu grupu, uz tendenciju povećanja sadržaja omega-3 masnih kiselina, alfa-linoleinske (ALA) i eikozapentaenske kiseline (EPA). Rezultati određivanja sastava masnih kiselina u ukupnim lipidima mozga pokazuju da primena *L. rhamnosus* LA68 dovodi do povećanja sadržaja palmitinske (18,28±2,78% vs 21,49±1,27%, p<0,05), stearinske (15,33±2,86% vs 21,04±2,17%, p<0,05), kao i arahidonske (AHA) (10,24±0,61 vs 12,03±0,66%, p<0,05) i dokozaheksaenske kiseline (DHA) (16,30±0,88% vs 19,08±0,87%, p<0,05) u odnosu na kontrolnu grupu. Primena *L. rhamnosus* LA68 tokom 12 nedelja u uslovima VSM ishrane dovela je do povećanja u sadržaju određenih zasićenih masnih kiselina u jetri, ali bez razlike u ukupnim zasićenim masnim kiselinama u odnosu na kontrolnu grupu. Takođe, uočeno je značajno povećanje u odnosu proizvoda i prekursora masnih kiselina omega-3 serije [(EPA+ DHA)/ALA)] (30,03 ± 7,38% vs 18,81 ± 6,77**%,** p<0,05), kao i smanjenja odnosa oleinske i stearinske kiseline u odnosu na kontrolnu grupu (2,48±0,59 vs 3,68±1,86%, p<0,05). Za razliku od jetre, nije uočen efekat primene *L. rhamnosus* LA68 uz VSM ishranu na sastav masnih kiselina mozga.
Prikazani rezultati jasno ukazuju da primena *L. rhamnosus* LA68 dovodi do različitih promena u sastavu masnih kiselina organa u zavisnosti od uslova ishrane što upućuje na to da i ovaj aspekt modulacije sastava masnih kiselina organa bi trebalo da bude intenzivnije proučavan

Effects of *Lactobacillus rhamnosus* LA68 administration on the fatty acid composition of the organs in the conditions of standard and high fat diet regime–animal case study

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In the literature, there are data indicating that application of certain lactic acid bacteria, and among them administration of lactobacili, could affect the fatty acid composition of organs such as the liver, brain and adipose tissue, and that the effects were strain-specific. Because of above mentioned, the aim of this work was to examine whether there is an influence of lactobacilli administration on the fatty acid composition of the liver and the brain of C57BL/6 mice during the standard diet and high-fat diet (HFD) regime.
The analysis of liver fatty acid profile during standard diet regime revealed that dietary intervention with *L. rhamnosus* LA68 during 4 weeks led to significant increase in palmitoleic acid (0.92±0.28% control versus 1.36±0.24% experimental group, p<0.05), while omega-3 fatty acids, a-linolenic acid (ALA) and eicosapentaenoic acid (EPA) were also increased, but not statistically significant (p>0.05). The results from analysis of the fatty acids compositon in total brain lipids show that administration of L. *rhamnosus* LA68 led to an increase in level of palmitic (18.28 ±2.78% versus 21.49±1.27%, p<0,05), stearic (15.33±2.86% versus 21.04±2.17%, p<0,05), arachidonic (AHA) (10.24±0.61% versus 12.03±0.66%, p<0.05) and docosahexaenoic acid (DHA) (16.3±0.88 versus 19.08±0.87%, p<0.05) compared to control group. Period of 12 weeks administration of *L. rhamnosus* LA68 in mice on HFD regime resulted in significant changes only in certain saturated fatty acids abundance in the liver tissue but there were no differences in total saturated fatty acids compared to the control group. We also found an increase in ration product and precursors of fatty acids omega-3 series [(EPA+ DHA]/ALA)] (30.03 ± 7.38% vs 18.81 ± 6.77**%,** p<0,05) in the liver, as well as the decrease in the ratio of oleic and stearic acid compared to the control group. Unlike the liver, there were no significant changes in the fatty acid composition of brain tissue upon administration of *L. rhamnosus* LA68 in HFD regime. The results presented in this study show that host tissue fatty acid composition is influenced by oral administration of *L. rhamnosus* LA68, depending on the diet regime. This suggests that aspect of host tissue modulation by probiotic bacteria should be more extensively examined.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZ11 / FH11 U/O

Mehanizam vazorelaksacije humane unutrašnje mamilarne arterije izazvane epikatehinom

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Epidemiološke studije su pokazale da je redovna upotreba hrane i pića bogatih flavanolima, kao što su kakao, jabuke, crveno grožđe i crveno vino, povezana sa smanjenim rizikom od kardiovaskularnih bolesti. Kardioprotektivni efekat epikatehina, kao glavnog aktivnog sastojka hrane bogate flavanolima, delom se može pripisati njegovom vazodilatatornom, antioksidativnom, antiproliferativnom i antiagregacionom dejstvu. Tačni mehanizmi kojima epikatehin izaziva vazodilataciju još uvek nisu razjašnjeni.
Ova studija imala je za cilj ispitivanje vazorelaksantnog dejstva epikatehina na izolovanoj unutrašnjoj mamilarnoj arteriji (HIMA) i definisanje mehanizama ove relaksacije.
Segmenti HIMA uzimani su od pacijenata tokom bajpas operacija i ispitivani u vodenom kupatilu.
Epikatehin je izazvao koncentracijski-zavisnu relaksaciju HIMA prekontrahovane fenilefrinom. 4-Aminopiridin i margatoksin, blokatori K_V kanala, i glibenklamid, blokator K_{ATP} kanala, delimično su inhibirali epikatehinom izazvanu relaksaciju HIMA, dok je iberiotoksin, selektivni blokator BK_{Ca}, potpuno blokirao relaksaciju. Epikatehin je delimično relaksirao HIMA kontrahovanu dodatkom 80 mM K^+, ali je izazvao punu relaksaciju arterijskih prstenova kontrahovanih fenilefrinom i kofeinom u medijumu bez Ca^{2+}. Tapsigargin, inhibitor Ca^{2+}-ATPaze sarkoplazmatskog retikuluma, blago je inhibirao relaksaciju HIMA kontrahovane fenilefrinom.
Ovi rezultati pokazuju da epikatehin izaziva snažnu endotel-nezavisnu relaksaciju HIMA kontrahovane fenilefrinom. U mehanizam ove relaksacije uključeni su 4-aminopiridin- i margatoksin-senzitivni K_V kanali, kao i BK_{Ca} i K_{ATP} kanali. Osim toga, izgleda da epikatehin može da inhibira ulazak ekstraćelijskog Ca^{2+}, ali i da utiče na oslobađanje intraćelijskog Ca^{2+} i njegovo ponovno preuzamanje u sarkoplazmatski retikulum.

Mechanism underlying the vasorelaxation of human internal mammary artery induced by epicatechin

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Epidemiological studies have provided evidence that the regular consumption of flavanol-rich foods and beverages, such as cocoa, apples, red grapes and red vine, is associated with reduced risk of cardiovascular diseases. Cardioprotective effects of epicatechin, as the main bioactive constituent of flavanol-rich food, might be attributed, in part, to its vasodilatory, antioxidant, antiproliferative and anti-aggregation effect. The exact mechanisms by which epicatechin causes vasodilation are still unclear.
The present study aimed to investigate relaxant effect of epicatechin on the isolated human internal mammary artery (HIMA) and its underlying mechanisms.
The HIMA segments were collected from patients undergoing coronary artery bypass grafting and studied in organ baths.
Epicatechin induced a concentration-dependent relaxation of HIMA pre-contracted by phenylephrine. Four-aminopyridine and margatoxin, blockers of K_V channels, and glibenclamide, a selective K_{ATP} channels blocker, partly inhibited the epicatechin-induced relaxation of HIMA, while iberiotoxin, a most selective blocker of BK_{Ca}, abolished the relaxation. Epicatechin partially relaxed HIMA pre-contracted by 80 mM K^+, while induced complete relaxation of rings pre-contracted by phenylephrine and caffeine in Ca^{2+}-free medium. Thapsigargin, a sarcoplasmic reticulum Ca^{2+}-ATPase inhibitor, slightly antagonized epicatechin-induced relaxation of HIMA pre-contracted by phenylephrine.
These results suggest that epicatechin induces strong endothelium-independent relaxation of HIMA pre-contracted by phenylephrine whilst 4-aminopyridine- and margatoxin-sensitive K_V channels, as well as BK_{Ca} and K_{ATP} channels, mediate this relaxation. In addition, it seems that epicatechin could inhibit influx of extracellular Ca^{2+}, interfere with intracellular Ca^{2+} release and re-uptake by the sarcoplasmic reticulum.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZ12 / FH12 U/O

Predloženi mehanizam uticaja oligosaharida dobijenih iz pektina na intestinalnu mikrobiotu

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Intestinalni trakt je najvažnije mesto za delovanje pektina i derivata pektina iz hrane. Veliki značaj ima u odbrani od patogenih organizama i ćelija kancera. Pektin je najvažnije rastvorno dijetetsko vlakno u jabukama i citrusima. Alkalnom hidrolizom sa vodonik-peroksidom smo dobili oligosaharide iz pektina (jabuka i citrusi) i poligalakturonske oligosaharide, koje smo analizirali infracrvenom spektrometrijom sa Furijeovom transformacijom. Pored toga, elektron paramagnetnom rezonantnom spin-traping spektorskopijom smo analizirali efekat oligosaharida iz pektina na hidroksil-radikal ($HO^{\cdot}$)-generisanu Fentonovu reakciju i na rast *Escherichia coli* i *Staphylococcus aureus* u prisustvu sistema koji generiše $HO^{\cdot}$- (gvožđe + askorbat). Oligosaharidi reaguju sa $HO^{\cdot}$ radikalom i proizvode ugljen-dioksid anjon radikal ($CO_2^{\cdot -}$). Komparativna analiza je pokazala da oligosaharidi koji potiču od pektina jabuke ima najjači bakteriostatski efekat. Radikal $CO_2^{\cdot -}$, koji je dobijen iz pektina jabuke generiše se 65% više u poređenju sa poligalakturonskom kiselinom i pektinom dobijenim iz citrusa, i može se smatrati da je glavni nosilac antimikrobne aktivnosti pektina iz jabuke.

Possible Mechanism of Pectin-Derived Oligosaccharides Influence on Gut Microbiota

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Intestinal tract appears to be the main site of beneficial actions of dietary pectin and pectin derivatives. It seems that this is especially important in the fight against the potentially *pathogenic* organisms and cancer cells. Pectin is the main soluble fiber in apples or citruses. We prepared pectin-derived oligosaccharides (apple and citrus) and polygalacturonic acid-derived oligosaccharides, using alkaline hydrolysis by hydrogen peroxide, and analyzed them by Fourier Transform Infrared spectrometry. Furthermore, we analyzed the effects of pectin-derived oligosacharides on hydroxyl radical ($HO^{\cdot}$)-generating Fenton reaction using electron paramagnetic resonance spin-trapping spectroscopy, and the effects on the growth of *Escherichia coli* and *Staphylococcus aureus* in the presence of dietary-relevant $HO^{\cdot}$-generating system (iron + ascorbate). The oligosaccharides react with $HO^{\cdot}$ radical to produce carbon dioxide radical anion ($CO_2^{\cdot -}$). A comparative analysis showed that apple pectin-derived oligosaccharides has the most prominent bacteriostatic effect. The production of $CO_2^{\cdot -}$, which was promoted by chemically processed pectin from apple by approximately 65% in comparison to processed polygalacturonic acid and citrus pectin, might be the main cause of the antimicrobial activity of the apple pectin derivative.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZ13 / FH13 U/O

Fenomen ukrštenih alergijskih obrazaca između alergena polena *Phleum pratense* i žitarica

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Ukrštena alergijska reakcija se pojavljuje zbog sličnosti između alergena polena i određenih proteina u hrani. Alergen polena trave mačiji rep (*Phleum pratense*) Phl p 1, pokazuje sličnost sa proteinima koji se prirodno nalaze u određenom voću i povrću. Glavni cilj ovog rada je determinacija korelacije između prisutnosti alergije na polen mačijeg repa i alergije na *Triticum vulgare* (pšenica) i *Avena sativa* (zob). Studija je izvedena na Odseku za biologiju na 30 ispitanika suspektnih na polensku alergiju. Unutrašnji deo podlaktice je dezinfikovan izopropil alkoholom te je kapljica vodenog rastvora polena mačijeg repa pomoću prick testa unesena hipodermalno. Prick-to-prick test je rađen za analizu alergijskih reakcija na pšenicu i zob. Ukupno je 15 ispitanika imalo izuzetno pozitivnu alergijsku reakciju na polen mačijeg repa (prečnik urtike >15 mm), dok je 10 njih imalo prečnik urtike između 10 mm i 15 mm. Najveća korelacija prečnika urtike je zabeležena između pšenice i zobi (R=0,998), dok je najniža negativna korelacija uočena između polena *Phleum pratense* i zobi (R=-0,630). Nekoliko zajedničkih epitopa su uočeni između polenskih alergena i žitarica. Ukrštena alergija između žitarica i polena trava se generalno smatra klinički nesignifikantnom, tako da bi trebalo sprovesti dalja istraživanja u smislu analize koncentracije IgE kod pacijenata alergičnih na polen trava i pojedine žitarice.

Phenomenon of cross reactivity patterns between allergens of *Phleum pratense* pollen and cereals

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Cross-reactivity in allergy occurs due to the similarity of the pollen allergens and certain food proteins. Timothy grass (*Phleum pratense*) pollen allergen Phl p 1, shows similarity with proteins that are found naturally in some fruits and vegetables. The main aim of this research was to determine the correlation between the presence of allergy to Timothy grass pollen and allergy to *Triticum vulgare* (wheat) and *Avena sativa* (oat). The study was conducted at Department of Biology on 30 examinees suspected on hay fever. The forearm was disinfected with iso-propyl alcohol and a drop of aqueous allergen solution of *Phleum pratense* was pricked with lancet hypodermal. A prick-to-prick test was used to analyze the allergic reaction to wheat and oat. A total of 15 individuals had extremely positive timothy grass allergy (diameter of hive >15 mm), whereas 10 examinees had hive diameter between 10 mm and 15 mm. The highest correlation in hive diameter was observed between wheat and oat (R=0,998), while lowest negative correlation was obtained between *Phleum pratense* pollen and oat (R=-0,630). A few common epitopes has been demonstrated between pollen allergens and cereals such as wheat and oat. Cross-reactivity among cereal grains and grass pollen is generally considered clinically insignificant so further investigations should be obtained in terms of IgE analysis in individuals allergic to grass pollen and certain cereals.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZ14 / FH14 U/O

Leptinska i insulinska osetljivost u hipotalamusu mužjaka pacova izloženih kombinovanom tretmanu ishranom bogatom fruktozom i hroničnim nepredvidivim stresom

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Ishrana bogata fruktozom i hronični stres predstavljaju bitne faktore nastanka metaboličkih poremećaja u razvijenim društvima. Leptin i insulin utiču na centralnu kontrolu unosa hrane, pa je cilj ovog istraživanja bio da se ispita da li devetonedeljni tretman ishranom bogatom 20% fruktozom i/ili četvoronedeljnim nepredvidivim stresom dovodi do poremećaja unosa hrane promenom signalizacije leptina i insulina u hipotalamusu Wistar pacova.
Iako je povećan kalorijski unos kod grupa životinja hranjenih fruktozom, telesne mase su ostale nepromenjene. Apsolutna i relativna masa visceralnog masnog tkiva (VMT) smanjeni su kod stresiranih životinja, kao i veličina adipocita, nezavisno od ishrane. Smanjena masa VMT praćena je i smanjenjem leptina u plazmi stresiranih životinja. Insulin i glukoza u plazmi pokazali su suprotnu promenu pod uticajem ishrane bogate fruktozom: glukoza je smanjena, a insulin povećan bez obzira na izloženost stresu. Međutim, smanjena tolerancija na glukozu uočena je samo kod nestresiranih životinja hranjenih fruktozom. Parametri insulinske signalizacije – nivo insulinskog receptora (IR) i inhibitorna fosforilacija supstrata za insulinski receptor ($pIRS^{Ser307}$) ostali su nepromenjeni u hipotalamusu svih tretiranih pacova. Udeo aktivne forme protein kinaze B (pAkt/Akt) je smanjen kod životinja izloženih kombinovanom tretmanu. Izraženo je smanjenje ekspresije gena za oreksigeni neuropeptid Y (NPY) kod svih tretiranih životinja, ali i smanjenje anoreksigenih neuropeptida – proopiomelanokortina (POMC) kod životinja izloženih kombinovanom tretmanu, i kokainom i amfetaminom regulisanog transkripta (CART) kod stresiranih životinja. Ekspresija gena za leptinski receptor (ObR) nije promenjena.
Nijedan od tretmana nije doveo do izražene promene osetljivosti na leptin i insulin u hipotalamusu pacova, mada je primetno da pri kombinovanom dejstvu stresa i fruktoze dolazi do povećanja kalorijskog unosa pri smanjenoj ekspresiji anoreksigenog POMC-a u hipotalamusu.

Leptin and insulin sensitivity in the hypothalami of rats subjected to fructose-enriched diet combined with chronic unpredictable stress

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Both high fructose diet and chronic stress may be important factors of metabolic disturbances in developed societes. Since leptin and insulin are involved in the central control of food intake, the main focus of this research was to determine whether a 9-week 20% fructose-enriched diet and/or 4-week chronic unpredictable stress treatment of Wistar rats affect the caloric intake via changes in hypothalamic leptin and insulin signalling.
Although an increase in caloric intake was seen in all fructose-fed animals, their body masses remained unchanged. Absolute and relative visceral adipose tissue (VAT) masses were decreased in stressed animals, as was the adipocyte size, regardless of the applied diet. This was congruent with the decrease of plasma leptin. Insulin and glucose plasma levels showed opposite changes after fructose diet, independently of stress: insulin was increased, while glucose was decreased. However, the decreased glucose tolerance was only seen in frucose-fed unstressed animals. Hypothalamic insulin signalling parameters – the levels of insulin receptor (IR) and inhibited form of its substrate ($pIRS^{Ser307}$) remained unaffected after all treatments. The share of activated protein kinase B (pAkt/Akt) was decreased in animals subjected to the combined treatment. The orexigenic neuropeptide Y was decreased in all treated groups, as were the anorexigenic neuropeptides – proopiomelanocortin (POMC) in stress plus fructose treated, and cocain- and amfetamine-regulated transcript (CART) in stressed animals. The leptin receptor gene expression was preserved after treatments.
None of the treatments induced a prominent change in the hypothalamic leptin and insulin sensitivity, although the inhibition of the anorexigenic POMC gene expression with concomitant increase in caloric intake was seen in the stressed rats on fructose diet.

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HZ15 /FH15 **U/O**

Efekti restrikcije hrane u 5XFAD mišijem modelu Alchajmerove bolesti

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Brojni literaturni podaci ukazuju da restrikcija hrane (RH) predstavlja najefikasniju negenetičku i nefarmakološku strategiju kojom je moguće produžiti životni vek i odložiti pojavu mnogih bolesti koje se javljaju sa starenjem. Kod životinja kojima je unos hrane smanjen je takođe utvrđeno znatno poboljšanje kognitivnih sposobnosti, međutim, mehanizmi neuroprotektivnog dejstva restrikcije hrane nisu u potpunosti razjašnjeni. Cilj ove studije je bio da se ispita efekat preventivne primene restrikcije hrane na parametre ponašanja i patološke promene kod 5XFAD miševa, animalnog modela Alchajmerove bolesti (AB). Promene u patologiji su praćene u kori velikog mozga i hipokampusu, strukturama mozga koje su bitne za procese učenja i pamćenja.
Eksperimentalne životinje (ženke starosti 2 meseca) su podeljene u dve grupe. Prva grupa, označena kao ad libitum (AL), je imala neograničen pristup hrani, dok je druga grupa (označena kao RH) podvrgnuta režimu redukovane ishrane koji je podrazumevao dobijanje 100% dnevnog unosa hrane AL životinja svakog drugog dana. Efekti su analizirani kod životinja starih 6 meseci, u starosnoj dobi u kojoj su sinaptički i poremećaji ponašanja jasno izraženi. Uprkos poboljšanjima koja su utvrđena u testovima za ispitivanje anksioznosti i kompulzivnog ponašanja, u kori velikog mozga nisu utvrđene promene u broju plaka, stepenu obrade amilodinog prekursorskog proteina, kao ni u nivou amiloida-beta nakon primene režima RH u prodromalnoj fazi bolesti. Utvrđen je, međutim, smanjen nivo pre- i post-sinaptičkih proteina, kao i porast inflamatornih i parametara koji ukazuju na pojačan stepen disregulacije glutamatergičkog sistema. Dobijeni podaci ukazuju da je preventivna primena RH dovela do pogoršanja patoloških parametara u kori velikog mozga 5XFAD miševa.

Limited Effects of Intermittent Fasting in 5xFAD Mouse Model of Alzheimer's Disease

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Food restriction (FR) paradigm is regarded as the most effective non-genetic and non-pharmacological strategy to improve healthspan and postpone age-related disorders. Numerous beneficial effects for both daily calorie reduction (CR) or intermittent fasting (IF) were found in various tissues and organs including brain. In the present study, we used 5XFAD transgenic mice, a commonly used transgenic mouse model of Alzheimer's disease (AD), to assess the effects of preventive IF treatment on behavioral and pathology-related parameters in the cortex and hippocampal formation, brain structures important for learning and memory.
IF was introduced to transgenic female mice at the age of 2 months, age period characterized by the onset of plaque deposition, and the effects were analyzed in 6-month-old animals when synaptic and behavioral deficits are established. Despite the partial improvement in behavioral phenotype of 6-month-old female mice, the full range of AD-like pathology in the cortical and hippocampal tissue of 5xFAD mice was mostly preserved. Namely, no IF-induced effects on plaque deposition, APP processing and Aβ42 levels were detected, suggesting that Aβ42 production, aggregation and clearance were not altered following moderate-long IF feeding regime that was introduced in prodromal phase of the disease. In contrast, IF feeding regime resulted in a further genotype-dependent decrease of pre- and post-synaptic plasticity-related protein levels in the cortex of 5xFAD mice with no change in the protein level of BDNF and TrkB. We further detected the increase in parameters of inflammation and glutamatergic system dysregulation. Collectively, the present data suggest that preventive IF feeding regime exacerbates pathology-like parameters in the cortex of 5xFAD mice.

HZ16 / FH16 U/O

Probiotički soj *Lactobacillus brevis* BGZLS10-17 ublažava simptome eksperimentalnog autoimunskog encefalomijelitisa kod DA pacova

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Multipla skleroza (MS) je hronično autoimunsko oboljenje centralnog nervnog sistema koje uglavnom pogađa mlade odrasle osobe i značajno smanjuje kvalitet života. Cilj ovog rada je bio izučavanje profilaktičkog i terapeutskog efekta probiotičkog soja *Lactobacillus brevis* BGZLS10-17, koji produkuje γ-aminobuternu kiselinu (GABA), na Dark Agouti (DA) pacovima kojima je izazvan eksperimentalni autoimunski encefalomijelitis (EAE), eksperimentalni model multiple skleroze. Pacovima su svakodnevno praćeni klinički simtomi EAE i ocenjivani su prema sledećoj skali: 0, bez kliničkih simptoma; 1, mekan, opušten rep koji pada; 2, pareza (delimična oduzetost) zadnjih udova; 3, paraliza (potpuna oduzetost) zadnjih udova; 4, životinja na samrti ili nastupila smrt. Rezultati ove *in vivo* studije su pokazali da oralna primena *L. brevis* BGZLS10-17 ublažava simptome EAE kod DA pacova. Naime, tretman probiotikom *L. brevis* BGZLS10-17 je odložio početak bolesti, skratio trajanje bolesti, smanjio intenzitet bolesti u periodu kada su simptomi kod kontrola najjače izraženi, a zanimljivo je i da se životinje nakon četrdeset dana potpuno oporavljaju, što kod kontrolnih životinja koje nisu bile tretirane probiotikom *L. brevis* BGZLS10-17 nije bio slučaj. Poboljšanje EAE simptoma je zabeleženo i nakon primene supernatanta soja *L. brevis* BGZLS10-17 gajenog 48 sati u medijumu za rast bakterija sa i bez dodatka prekursora GABA, monosodijum glutamata (MSG). Dobijeni rezultati ukazuju da je GABA koju proizvodi soj *L. brevis* BGZLS10-17 odgovorna za ublažavanje simptoma EAE, što će biti predmet daljih istraživanja kako bi se procenio efekat soja *L. brevis* BGZLS10-17 i GABA u autoimunskim bolestima.

Administration of *Lactobacillus brevis* BGZLS10-17 alleviates symptoms of experimental autoimmune encephalomyelitis in DA rats

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Multiple sclerosis (MS) is a chronic autoimmune disease of the central nervous system, which mainly affects young adults and has a high impact on everyday life. In this study, we evaluated the prophylactic and therapeutic effects of orally administered *Lactobacillus brevis* BGZLS10-17 probiotic strain, with high γ-aminobutyric acid (GABA)-producing ability, on Dark Agouti (DA) rats with experimental autoimmune encephalomyelitis (EAE), the experimental model of multiple sclerosis. The rats were monitored daily for clinical signs of EAE and scored according to the following scale: 0, no clinical signs; 1, flaccid tail; 2, hind limb paresis; 3, hind limb paralysis; 4, moribund state or death. The results of this *in vivo* study showed the ability of *L. brevis* BGZLS10-17 to decrease disease severity in DA rats. Treatment with *L. brevis* BGZLS10-17 delayed disease manifestation and shortened the duration of the disease, while the peak of the disease is entirely reduced and the animals are completely recovered after forty days that was not observed in control animals. The aggravation of the EAE symptoms also occurred when supernatants of the *L. brevis* BGZLS10-17 grown for 48 h in the growth medium supplemented with monosodium glutamate (MSG) or without MSG were used. Our results clearly indicated the role of GABA produced by *L. brevis* BGZLS10-17 in improvement of EAE prognosis and support further investigations to evaluate their beneficial effects in autoimmune diseases.

HZ17 / FH 17 U/O

Zoonotske protozoe svinja prenošene hranom – ima li efikasne prevencije?

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Stalan rast svetske populacije zahteva i stalno povećanje proizvodnje hrane, što je posebno očigledno u proizvodnji svinjskog mesa poslednjih godina. Broj svinja je 2015. godine premašio milijardu, a 2017. proizvedeno je rekordnih 111 miliona tona svinjskog mesa. Uprkos ekspanziji i dominaciji specijalizovanog industrijskog uzgoja u razvijenim zemljama, paraziti svinja, uključujući protozoe, i dalje predstavljaju problem, posebno u tradicionalnom uzgoju na malim gazdinstvima. Ovo je još jedan dokaz o neophodnosti primene *One Health* pristupa u rešavanju problema zoonotskih infekcija. Pored tkivnih protozoa *Toxoplasma gondii* i *Sarcocystis suihominis*, intestinalne vrste protozoa kao što su *Balantidium coli*, *Blastocystis hominis*, *Entamoeba polecki*, a moguće i *Cryptosporidium* i *Giardia spp.*, imaju zoonotski potencijal kao zagađivači vode ili hrane odn. kao uzročnici feko-oralne infekcije. Kako SZO i FAO procenjuju da je opterećenje bolešću kod toksoplazmoze slično onome kod salmoneloze i kampilobakterioze, što ga čini najvećim od svih parazitskih infekcija, neophodno je preduzimanje preventivnih mera. Idealno bi bilo delovati na sva četiri nivoa – na farmi, klanici, obradi nakon klanja i na nivou potrošača. Ovo tim pre što je zoonotske protozoe koje se prenose mesom praktično nemoguće detektovati prilikom klanja, makar ne na ekonomski isplativ način. Situaciju komplikuje činjenica da ne postoji (apsolutna) korelacija izmedu rezultata seroloških ispitivanja i parazitološkog nalaza (tj. prisustva vijabilnih tkivnih cista), a ni primenom skupih metoda molekularne detekcije zasnovanih na PCR-u, uprkos svojoj specifičnosti i osetljivosti, ne mogu se sa 100% sigurnošću identifikovati životinje koje predstavljaju rizik za ljudsko zdravlje. Zbog toga je i danas jedini način da se svinjetina učini bezbednom za ljudsku upotrebu primena metoda kao što su zamrzavanje, pravilno usoljavanje i sušenje, a na nivou potrošača, pravilna termička obrada mesa.

Foodborne zoonotic protozoa transmitted by pigs – too much on our plate?

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The constant growth of the global population leads to an increase in food production, which has been particularly evident in the production of pork in the recent years. In 2015, the number of pigs has surpassed one billion, and in 2017 a record high of 111 million tonnes of pork was produced worldwide. In spite of the expansion and dominance of specialized industrial farming in developed countries, pig parasites including protozoa, remain a problem, particularly in traditional small-scale farming. This is yet another argument in favour of the One Health approach in tackling the problem of zoonotic infections. Aside from the pork-borne *Toxoplasma gondii* and *Sarcocystis suihominis*, intestinal protozoa such as *Balantidium coli*, *Blastocystis hominis*, *Entamoeba polecki*, and possibly *Cryptosporidium* and *Giardia spp.*, have a zoonotic potential as contaminants of water or food leading to a faeco-oral infection. As the WHO and FAO estimate the disease burden of toxoplasmosis to be similar to that of salmonellosis and campylobacteriosis, making it the highest of all parasitic infections, it is imperative that preventive measures be undertaken. Ideally, all four levels should be included – farm, slaughter, post-harvest processing, and consumer level. This is even more important since it is virtually impossible to detect meat-borne zoonotic protozoa at slaughter, at least not in a practical and cost-effective way. The problem is that there is no (absolute) correlation between the results of serological tests and parasitological findings (i.e. the presence of viable tissue cysts), and not even the use of expensive molecular methods (PCRs), despite their specificity and sensitivity, allows for a 100% accuracy in detecting animals unsafe for human consumption. Therefore, the application of post-harvest methods including freezing, proper salting/curing, and sufficient cooking at the consumer level, remain the realistic approach to rendering pork safe for human consumption.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZ18/ FH18 U/O

Razvoj tehnloškog postupka za proizvodnju inovativnog fermentisanog probiotika za prevenciju i tretman crevnih infekcija kod životinja

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Povećan interes za korišćenje probiotika u stočarskoj proizvodnji je nastao 2006. godine nakon što je Evropska Unija zabranila upotrebu antibiotika kao faktora za stimulisanje rasta domaćih životinja. Cilj ovog rada je bio razvoj tehnološkog procesa za proizvodnju inovativnog fermentisanog probiotika za životinje. To je uključivalo optimizaciju i standardizaciju tehnološkog procesa za proizvodnju fermentisanog probiotika (sa najvećim brojem živih metabolički aktivnih probiotičkih bakterija, minimalno 1 x 10^8 cfu/ml i sa dobrim senzornim karakteristikama, definisan pH finalnog proizvoda ne niži od 4.4), u skladu sa HACCP principima, kako bi se osigurala reproducibilnost tehnološkog procesa i dobio najviši kvalitet finalnog proizvoda. Za fermentaciju je korišćena mešana probiotička kultura u čiji sastav ulaze prirodni izolati *Lactobacillus helveticus* BGRA43, *Lactobacillus fermentum* BGHI14 i *Streptococcus thermophilus* BGVLJ1-44, za koju je prethodno pokazano da deluje preventivno i terapijski na crevne infekcije izazvane teško izlečivim patogenim bakterijama. Kao medijum za fermentaciju je korišćena rekonstituisana sirotkina u prahu za životinje (7%), pasterizovana na 65ºC/30 min (šaržna pasterizacija). Inokulacija i fermentacija rađena su na 42ºC, dok pH nije dostigao vrednost od 5,00. Zatim je završeno hlađenje i pakovanje finalnog proizvoda. Monitoring finalnog proizvoda je pokazao da je broj živih i metabolički aktivnih probiotičkih bakterija na kraju proizvodnje bio ≥ 1 x 10^8 cfu/ml, pH vrednost proizvoda je bila stabilna i proizvod je pokazivao dobre senzorne karakteristike. Određen je i rok trajanja od 28 dana. Tokom tog perioda broj živih i metabolički aktivnih probiotičkih bakterija je ostao nepromenjen, a nakon dužeg perioda skladištenja broj živih i metabolički aktivnih probiotičkih bakterija se postepeno smanjuje.

Development of technological process for scale-up production of innovative fermented probiotic for prevention and treatment of intestinal infections in animals

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The increased interest in use of probiotics in livestock has arisen since 2006 when the use of antibiotics as growth promoting factors in livestock has been banned by European Union. The aim of this study was the development of technological process for production of innovative fermented probiotic for animals. This included optimization and standardization of scale-up technological process for production of dairy fermented probiotic (with highest number of metabolically active probiotic bacteria, at least 10^8 cfu/ml and with good sensory characteristics, defined pH of the final product not lower than 4.4), in line with HACCP principles, in order to ensure reproducibility of technological processes and to gain the highest quality of the final products. Previously defined mixed probiotic culture, encompasing natural isolates *Lactobacillus helveticus* BGRA43, *Lactobacillus fermentum* BGHI14 and *Streptococcus thermophilus* BGVLJ1-44 that has strong probiotic effect in prevention and treatment of intestinal infections caused by severely curable pathogenic bacteria, was used for fermentation. Fermentation was performed in reconstituted whey powder for animals (7%), pasteurized at 65ºC/30 min (batch pasteurization). Inoculation and fermentation was done at 42ºC, until pH reached the value of 5,00. Afterwards, cooling and packaging of the final product were completed. Monitoring of the final product showed that at the end of production the number of live and metablicaly active probiotic bacteria was ≥ 1 x 10^8 cfu/ml, pH value of the product was stable and it had good sensory characteristics. The shelf life of 28 days was determined. During that period the number of live and metablicaly active probiotic bacteria remained the same while after longer storage period the number of life and metabolically active probiotic bacteria gradually decreased.

HZ19/ FH19 U/O

Navike i stavovi omladine o regularnom unosu obroka i afinitetu prema određenim namirnicama

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Nepravilnosti u konzumiranju obroka pored prekomernog unosa visoko kalorične i brze hrane predstavljaju rastući problem koji utiče na zdrav način ishrane omladine. Ovo istraživanje sprovedeno je sa ciljem da se prikupe informacije o navikama u ishrani u pogledu neredovnosti konzumiranja obroka i učestalosti konzumiranja određenih namirnica u vidu anketnog upitnika na uzorku od 525 ispitanika (42,5% dečaka i 57,5% devojčica) uzrasta od 11 do 18 godina. U istraživanju su učestvovali učenici petog i sedmog razreda osnovnih škola i trećeg razreda srednjih škola u Vojvodini. Istraživanjem je obuhvaćeno 525 ispitanika većinom nastanjenih u ruralnim područjima.
Na osnovu dobijenih rezultata, neredovnosti konzumiranja doručka među omladinom uzima maha budući da je 11,05% ispitanika izjavilo da ne konzumira doručak dok se večera izbegava u manjoj meri (2,86%). Većina ispitanika na dnevnom nivou konzumira supu i salatu (58,29% and 38,67%, respektivno). Meso je veoma zastupljeno u ishrani omladine sa učestalošću od 2 do 4 puta nedeljno dok se riba retko konzumira (jednom do dva puta mesečno).

Young population habits and attitudes towards meals intake regularity and food preference

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Irregularities in meal intake beside excess intake of high caloric and fast foods represent emerging problem affecting young population healthy diet. The presented study was conducted in order to assess established dietary habits of the young population regarding irregularities in meals intake and food choice preference. In this regard, a questionnaire survey was applied to a sample population of 525 voluntary participants (42.5% males and 57.5% females) with age ranging from 11 to 18. Surveyed participants were students attending 5th and 7th grade in elementary schools and 3rd grade in high schools located in the province of Vojvodina, Serbia.
According to the obtained results, irregularities in breakfast intake are becoming common among young population since 11.05% of all participants stated that breakfast was excluded from their diet while dinner was excluded from the diet in lesser extent (2.86%). Majority of the participants consumed soup and salad on daily basis (58.29% and 38.67%, respectively). Meat is frequently a part of the young population diet (2-4 times per week) while fish is consumed scarcely (1-2 times per month).

HZ20 / FH20 U/O

Veza stanja uhranjenosti djece i navika u ishrani

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Cilj istraživanja bio je da se utvrdi povezanost stanja uhranjenosti sa navikama u ishrani djece predškolskog uzrasta. Istraživanjem je obuhvaćeno 60 djece. Antropometrijska merenja obuhvatila su mjerenje visine i težine. Utvrđeno je da nema statistički značajne razlike u visini i težini među polovima. U ispitivanoj populaciji nije bilo djece koja zaostaju u rastu, dok je 7% imalo prekomjerni rast. Procjena uhranjenosti izvršena je na osnovu indeksa tjelesne mase (BMI). Najviše ispitanika, 57% djevojčica i 63% dječaka, imalo je normalnu tjelesnu težinu. Prekomjernu težinu imala je jedna šestina ispitanika, pri čemu su dječaci bili brojniji, ali nisu pronađene statistički značajne razlike među polovima. Dok je zastupljenost prekomjerne tjelesne mase slična, u kategoriji gojaznosti bilo je 14% devojčica i 19% dečaka. Ukupno 13% ispitanika bilo je neuhranjeno pri čemu su djevojčice zastupljenije.
U svrhu istraživanja navika u ishrani ispitivane populacije korišten je upitnik-anketa ishrane.. Upitnik su popunjavali roditelji djece uključene u ovo istraživanje. Upitnik se sastojao iz dva dijela. Prvi dio nam je dao informacije o navikama u ishrani porodice (najčešće korištene namirnice, dostupnost namirnica i sl.) i unosu pojedinih grupa namirnica, a drugi dio nam je dao podatke o odnosu prema ishrani djece (navike vezane za večeru djece, postojanje dodatnog obroka-užine, konzumaciju slatkiša i osvježavajućih bezalkoholnih zaslađenih napitaka i sl.). Anketa ishrane ukazala je na loše navike u ishrani djece. Svi ispitanici konzumiraju slatkiše, grickalice i zaslađene napitke, najviše njih bar jednom dnevno (65%), a od ovog broja čak polovina ispitanika konzumira ove proizvode više puta na dan, pri čemu nema statistički značajne razlike između dječaka i djevojčica. Ishranu pothranjenih karakteriše nedovoljan unos mesa.

Correlation of nutritional status and eating habits in children

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The aim of the research was to determine the correlation of nutritional status and the eating habits of preschool children. The survey included 60 children.
Anthropometric measurements such as weight and height are included. It is determined that there isn't a statistically significant difference in height and weight between the sexes. Among the examined children, none of them had growth delay, but 7% of children had an excessive growth. Nutritional assessment was based on body mass index (BMI). The highest number of respondents, actually 57% of girls and 63% of boys had normal body mass. One-sixth of the respondents were overweight, particularly boys; however there was no statistically significant difference between the sexes. Overweight body mass was similar, although 14% of girls and 19% of boys were classified as obese. The total of 13% of respondents were undernourished, girls in particular. In order to investigate the eating habits of surveyed population, a nutrition questionnaire was used. The questionnaire was filled out by the parents of children involved in this research. The questionnaire was consisted of two parts. The first part gave us information about habits in the family's diet (the most commonly used food, availability of foodstuffs, etc.) and the consumption of certain groups of foods, while the other part gave us nformation on the relation to the children's nutrition (habits related to children's diets, the existence of an additional meal - drinking, consuming sweets and refreshing non-alcoholic sweetened drinks, etc). The questionnaire about nutrition indicates bad habits related to children's nutrition. All respondents consume sweets, snacks and sweetened drinks at least once a day (65%) and half of the respondents consume these products several times a day; there is no statistically.

HZ21 / FH21 U/O

Zdravom ishranom do zdravog života (https://youtu.be/-ZBwDOc16A4)

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Zdrave navike u ishrani dece od najvećeg su interesa po procenama mnogobrojnih nacionalnih i međunarodnih Agencija zbog unapređenja stila života. Deca uobičajeno unose više hrane i napitaka po kilogramu telesne mase od odraslih. Njihove navike u ishrane se razlikuju od navika odraslih i manje variraju tokom različitih stadijuma razvoja. Kao najznačajniji cilj našeg projekta o podizanju nivo svesti kod dece o zdravim navikama u ishrani, snimljen je film za adolescente, odštampana brošura, a pripremljen je i priručnik za nastavnike. Edukativni materijal je nastao kao proizvod saradnje i komunikacije stručnjaka različitih profesija: toksikologa, prehrambenih inženjera, nutricionista, biotehnologa, biologa, školskih psihologa, lingvista, dizajnera internet stranica i producenata dokumentarnih filmova. Da bi postigli podizanje nivoa svesti ciljne grupe našeg projekta, obuhvatili smo upoznavanje sa osnovnim znanjima o izvorima hrane, njenoj funkciji i pravilnom izboru, sigurnosti namirnica, ključunim faktorima za njihov odabir, nabavku, skladištenje, pakovanje, pripremu, konzumiranje, kao i rizicima od gojaznosti i kontaminanata hrane.
Materijali za edukaciju (film, dodatni materijal i priručnik za nastavnike) su najpre izrađeni na engleskom jeziku, a zatim prevedeni na Turski, Hrvatski, Španski i Katalonski jezik. Da bismo procenili efikasnost uticaja filma na školsku decu u Turskoj, Španiji i Hrvatskoj, jednoj grupi dece je dat test pre i posle gledanja filma, drugoj posle gledanja filma, a treća grupa nije imala uvid u film. Preliminarni rezultati pokazuju da se film pokazao delotvornim, tj. povoljno je uticao na povećanje nivoa svesti kod ciljne grupe dece u pogledu bezbednosti hrane i njihovih zdravih navika u ishrani.

Healthy food for healthy life (https://youtu.be/-ZBwDOc16A4)

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Healthy habits in child nutrition are among the priorities for many international or national authorities to improve the life style and to guide with effective policies. Children consume more food and beverages per kilogram of body weight than do adults, and their dietary patterns are different and often less variable during different developmental stages. As the main goal of our project on 'raising the awareness of the children on food safety and healthy eating habits', a film for adolescents, a supplementary text book, and a manual for teachers have been developed. Mentioned educational tools are the achievements of the collaboration, communication and contribution of different professionals from toxicology, food engineering, nutrition, food biotechnology, biology, education psychology and guidance, science education, curriculum development, measuring and evaluation, language scientists, web page design and documentary film production. To raise the awareness of the target group, our project content comprised: basic knowledge on nutrition sources and functions, healthy food choices, safety clues on food, purchasing, storage, preparation steps, healthy food consumption, obesogenic environment and food contamination. The educational materials (film, supplementary text book and manual for teachers) developed in English have been translated to Turkish, Spanish, Croatian and Catalan. In order to evaluate effectiveness of the film, an achievement test was used and administered in schools in Turkey, Spain and Croatia. Preliminary results show that, our film has been found effective that means it raised the awareness of our target group on food safety and healthy eating habits significantly.

Key words: food safety, adolescents, education, health

Minimalism in food analysis, but maximal information

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High-performance thin-layer chromatography (HPTLC) is a technique that can be combined with many kinds of detectors and bioassays because of its flexible handling and open chromatographic system. The combination of HPTLC and mass spectrometry (MS) made it an ideal tool for effect-directed analysis (EDA). As the layer is used only once, sample preparation on the plate and chromatography can be combined. This also means that samples can be analyzed as natural as possible. Matrix can remain at the start zone or be shifted to the front. However, it is still accessible for the non-target bioassay detection and not out-of-focus. The chromatogram is immersed into the bioassay and evaluated instantly or incubated for few hours, depending on the bioassay or enzymatic assay selected. After a visualization step, only the effective compound zones are visible in a complex sample that may consist of thousands of single compounds. HPTLC and especially modern direct bioautography in combination with image evaluation techniques and high-resolution (HR) MS may answer analytical questions rapidly, which may not be solved with other techniques that fast and simple. Hyphenated planar chromatography (HPTLC-UV/Vis/FLD-EDA-HRMS) proved to be well-suited as high-throughput bioanalytical technique (bioprofiling) that contibutes with instrumental and methodical minimalism to maximal information.

Open source 3D printed add-on for automated elution head-based HPTLC-MS

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The hyphenation of elution head-based high-performance thin-layer chromatography mass spectrometry (HPTLC-MS) still has to be operated manually in terms of plate positioning. Thus, an open-source 3D printed add-on is introduced [1], allowing an automatization of the TLC-MS Interface 2 from CAMAG. A newly developed software termed OC_manager controls the image-based assignment of elution zones and the automated positioning of the elution head on those zones. By the use of an automatic 6-port valve and four electronically controlled pneumatic valves, the elution and cleaning process can be adjusted individually and synchronized with the plate positioning and MS data acquisition. Mechanic movements were realized by three belt-driven carriages directly on the interface base. The 6-port valve and all pneumatics were installed inside the device to preserve the compact footprint. The mean deviation (target shift) of the positioning was determined to be 160 µm for the ordered elution of 294 target zones of azophloxine on one HPTLC plate and to be 190 µm for the randomized elution order. The head cleaning control was improved, and remaining elution solvents and particles are completely transferred to the drawer. In combination with a controllable gas flow over the elution zone, cross-over contaminations or chromatogram distortion by released layer particles or solvents are avoided. The presented automatization turns HPTLC-MS to be a highly efficient and reproducible hyphenation technique.

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Optimization of the extraction of phenolic compounds from chestnut tree flowers

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The chestnut tree fruits represent one of the most economically important agro-food material in the northeaster region of Portugal. Tones of bio-residues are generated annually (branches, leaves, flowers, etc) and used, in the better cases, as natural fertilizers or, in a less environmental friendly cases, burned. Otherwise, scientific reports have been relating the consumption of some synthetic compounds present in foods with undesirable effects on the human health. Such results are pushing the food-industry to look for alternatives that meet consumer needs towards a more natural market. Therefore, the aim of this work was to valorise chestnut flowers' (CF) bio-residues and to develop a profitable natural antioxidant.

Although less exploited for economical purposes, CF have been used since ancient times in the preparation of infusions due to the high concentration of active phenolic compounds (PC) beneficial to the human health. Recent research has shown that CF possesses high abundance of PC that can be used in the preservation of foods due to their capacity to inhibit lipid peroxidation and microbial proliferation. However, to compete with the price-value of synthetic antioxidants typically applied, the PC extracted from CF need to be maximized. Therefore, the conditions of time (t), temperature (T) and solvent (S) that favours the extraction by maceration of PC were optimized by response surface methodology using a 5-level experimental design. The responses used as criteria were the quantification of the fourteen individual PC by HPLC-DAD and the extraction yield of the obtained extract (E). The models developed were successfully fitted to the data and used to determine optimal extraction conditions (t= 120.0±12.4 min, T= 85.0±6.7 ºC and S= 44.5 % of ethanol) producing 55.37±2.20 mg PC/g E.

The results highlight the potential of valorising CF bio-residues as a productive source of PC for the development of a natural preservative that may be able to compete with synthetic compounds typically applied in the food-industry.

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BKH4 / FQS4 U/O

Hemijska analiza i procena botaničkog porekla nekih malteških medova

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Malteška ostrva poznata su po proizvodnji meda različitog botaničkog porekla. Još od davnih vremena Malta je povezana sa proizvodnjom meda (grčki Melita - zemlja meda). Cilj ovog rada bio je hemijska analiza i procena botaničkog porekla nekih malteških medova. Na malteškim ostrvima pčelari med mogu sakupljati tri puta tokom jedne godine, u proleće, leto i jesen. Tako, svaki sezonski med poseduje specifičan organoleptički ukus, jer potiče od različitih sezonskih biljaka. Fizičko-hemijska analiza medova bazirana je na harmonizovanim metodama po Bogdanov-u. Analiza šećera izvršena je jonskom hromatografijom (HPAEC) sa pulsno-amperometrijskom detekcijom (PAD), dok je polifenolni profil malteških medova okarakterisan pomoću UHPLC-DAD MS/MS tehnike. Polenska analiza urađena je uz poštovanje harmonizovanih metoda melizopalinologije. Analiza šećera pokazala je da je sadržaj fruktoze 1,1 puta veći od sadržaja glukoze, kao i da sadržaj turanoze i rafinoze raste dok sadržaj saharoze i maltoze opada od proleća do jeseni..Polifenolni profil pokazuje da su u svim uzorcima najzastupljenije fenolne kiseline (p-kumarinska, siringinska,vanilinska). Melisopalinološka analiza meda pokazala je da u proleće i leto dominira Lotus, dok u jesen preovladava Eukaliptus.

Chemical analysis and evaluation of botanical origin of some Maltese honeys

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The Maltese Islands are renowned for the production of genuine honey from different floral sources, depending on the season and the location of the apiary. The connection of Malta with honey is most evident from the ancient name of the island which was *Melita*, originating from Greek language and means land of honey. The aim of this paper was chemical analysis and evaluation of botanical origin of some Maltese Honeys. In the Maltese Island the beekeeper can harvest honey three times during a single year, in spring, summer and autumn. Each season's honey has its own particular organoleptic taste since they originate from different floral sources. Physiochemical analysis of honeys was based on the *Bogdanov* harmonized methods. The carbohydrate analysis was performed by ion exchange chromatography (HPAEC) with pulsed amperometric detection (PAD), while the polyphenolic profile of the Maltese honey was evaluated by UHPLC–DAD MS/MS technique. The melissopalynological analysis was performed in accordance with Harmonised Methods of Melissopalynology. The sugar analysis revealed that fructose glucose ratio was 1.1, as well as concentration of turanose and raffinose increased whereas pointed out that maltose and sucrose decreased through seasons. The polyphenolic profile pointed out that the most abundant were phenolic acids(p-coumaric, siringic vanilic). The melissopalynological analysis showed that Lotus pollen was dominant in spring and summer, whereas the Eucalitus was in autumns samples.

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BKH5 / FQS5 U/O

Полифенолни и шећерни профил меда од хељде

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Хељдин мед привлачи пажњу као важна функционална храна захваљујући садржају различитих једињења за која је показано да имају антидијабетско, антиоксидативно, антиинфламаторно и антиканцерогено дејство. Једињења која доприносе овим ефектима су значајна за истраживање. Ова студија се заснива на испитивању профила шећера и полифенола у шест узорака меда од хељде и једном узорку нектара хељде. Методом јонске хроматографије са електрохемијском детекцијом (*HPAEC/PAD*) квантификовани су присутни шећери, док је полифенолни профил одређен методом високо-ефикасне течне хроматографије са масеном детекцијом (*UHPLC-LTQ OrbiTrap XL*). Садржај глукозе и фруктозе је у опсегу од 312 до 355 g/kg, односно 327 до 386 g/kg. Концентрације флавоноида (галангина, хрисина и пиноцембрина) су благо различите, а највише је кверцетина, 26,4 mg/kg. Главне фенолне киселине су *p*-кумаринска, *p*-хидроксибензоева, кафеинска и ферулинска. Концентрације девет флавоноид-глукозида веома су различите, а само је кверцетин-3-*O*-рамнозид пронађен у свих седам узорака. На основу презентованих резултата, може се рећи да мед од хељде има значајну нутритивну вредност.

Polyphenol and sugar profile of buckwheat honey

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Buckwheat honey has attracted increasing attention as an important functional food thanks to its components that are known to have beneficial impact such as anti-diabetic, anti-oxidative, anti-inflammatory, anti-cancerogenic. Therefore, compounds that have impact on these effects are of the great interest. This study is based on investigation of sugar and polyphenol profile in six buckwheat honey samples and one pure buckwheat nectar sample. High-performance anion-exchange chromatography with pulsed amperometric detection (HPEAC/PAD) was used for sugars quantification, while ultra-high-performance liquid chromatography coupled with hybrid mass spectrometry detector (UHPLC-LTQ OrbiTrap XL) was used for polyphenolic profile characterization. Glucose and fructose content was from 312 to 355 g/kg, and from 327 to 386 g/kg, respectively. Concentration of flavonoids (galangin, chrysin and pinocembrin) were slightly different, while quercetin was dominant with concentration of 26.4 mg/kg. The main phenolic acids were *p*-coumaric, *p*-hydroxybenzoic, caffeic, and ferulic acid. Concentration of nine identified flavonoid glycosides were various and only quercetin 3-*O*-rhamnoside was found in all investigated samples. Based on our results, it can be concluded that buckwheat honey has a significant nutritional value.

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Hemijska analiza i analiza botaničkog porekla medova iz Albanije

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Pozitivan uticaj meda na ljudsko zdravlje čini ga jednim od najvrednijih proizvoda u Albaniji. Monoflorni medovi kao što su kestenov, bargremov i med od planike su veoma skupi. Zbog visoke cene monoflorni medovi se često modifikuju. U Albaniji ima veoma malo radova o karakterizaciji monoflornog i poliflornog meda proizvedenog u različitim regionima Albanije, zbog toga je veoma teško da se proceni botaničko i geografsko poreklo meda. 2007 godine uvedena je regulativa o medu u skladu sa direktivom Evropske unije (2001/110/EC). Međutim izostala je praktična primena i formiranje odgovarajućih kontrolnih tela. Cilj ovog rada je proučavanje karakteristika monoflornih medova skupljenih od pčelara u Albaniji u saradnji sa Pčelarskim savezom Albanije. Fizičkohemijski parametri su određeni na osnovu IHC harmonizovanih metoda dok je šećerni profil određen HPAEC/PAD tehnikom. Dobijeni rezultati su upoređeni sa referetnim tabelama za monoflorne medove.

Chemical Analysis and Evaluation of Botanical Origin of Some Albanian Honeys

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Honey is considered as a very precious product in Albania due to its health benefits. Unifloral honeys, especially chestnut, acacia, strawberry tree etc, are sold with a higher price. Due to its high price, honey, especially unifloral has been often adulterated.
In Albania, there is very little research papers related to the characterization of honeys produced in different areas of Albania, neither for unifloral or polifloral honeys. Hence it is very difficult to evaluate botanical and geographical origin of honey. In 2007 the law regulation about honey, in accordance with European Union Directive (2001/110/EC) was adopted. But in practice till the present there is no public agency to monitor honey quality based on adopted regulation. Also there is no directive to determine properties and botanical origin of unifloral honeys. The aim of this work is to analyze unifloral honey samples collected from Beekeepers, in collaboration with Albanian Association of Beekeepers. Physicochemical analysis of honeys was based on IHC harmonized methods, whereas carbohydrate analysis was performed by ion exchange chromatography (HPAEC) with pulsed amperometric detection (PAD). The results obtained were compared with the main European unifloral honeys descriptive sheets.

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BKH7 / FQS7 U/O

Ficus carica L. infructescence exploitation for anthocyanin-rich extracts preparation: optimized extraction, bioactivity, and application as food colorant

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Given its coloration, the peel of the infructescence of *Ficus carica* L. a by-product of fruit processing and/or consumption, was considered as a potential source of anthocyanin compounds. In the present study, different extraction techniques (heat, ultrasound, and microwave), aiming to recover the anthocyanin pigments and optimize its extraction, were compared by response surface methodology using a circumscribed central composite design of three variables with five levels. The relevant tested and optimized variables were time, temperature, and solvent composition (ethanol/water ratio) for heat and microwave extraction methods. For ultrasound method, the variables were the ultrasonic power, time, and solvent composition. The anthocyanin profile of the extract was determined by HPLC-DAD-ESI/MS, and the used criteria responses were the quantification of cyanidin 3-rutinoside (*C*) in the extracted residue (R; mg *C*/g R) and in the dried fig peel (P; mg *C*/g P dw), and the extraction yield of the obtained residue (g R/g P dw). Ultrasound extraction was the most effective method, yielding 17.0 mg *C*/g R, 3.11 mg *C*/g P dw, and 0.19 g R/g P dw at the optimal global extraction conditions (21 min, 310 W, and 100% of ethanol). Regarding its bioactive properties, the fig peel optimized extract showed antioxidant activity with an EC_{50} value of 2,447 mg/mL in the TBARS method and EC_{80} values of 52 and 1.62 mg/mL, in 60 and 120 min, respectively, in the OxHLIA assay. The extract also revealed antimicrobial activity in different Gram-positive and Gram-negative bacteria and did not present cytotoxicity against non-tumour cells. Its application in a food product was carried out through the preparation of a donut topping. The obtained results highlight the potential application of *F. carica* peels as sources of anthocyanins to be considered in food industry, adding the benefits derived from its antioxidant and antimicrobial activity to the colorant power.

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BKH8 / FQS8 U/O

Biološko profilisanje ekstrakata *Saccharina japonica* primenom planane hromatografije povezane sa biološkim esejima

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Smeđe alge, *Saccharina japonica* (Areschoug) C.E. Lane, C. Mayes, Druehl & G.W. Saunders, (syn. *Laminaria japonica*) su najčešće korišćena morska hrana u Severnoj Aziji. *S. japonica* predstavlja bogat izvor masnih kiselina, proteina, dijetetskih vlakana, kao i razlicitih sekundarnih metabolita. Biološki aktivna jedinjenja koja ulaze u sastav morskih trava ispoljavaju različita svojstva kao što su antibakterijska, antioksidativna, antifungalna i antivirusna. Cilj ovog istraživanja je identifikacija jedinjenja iz morskih trava (*Laminaria japonica*) koja ispiljavaju potencijalnu antioksidativnu i antimikrobnu aktivnost primenom nove, brze, i visokopropusne tehnike u kombinaciji sa UPLC-*LTQ XL ion trap MS. Uzorci morskih trava prikupljeni na privatnoj farmi na ostrvu Deokjeok, Južna Koreja su ekstrahovani metanolom. Nakon toga, ekstrakti su analizirani visokoefikasnom tankoslojnom hromatografijom (HPTLC).* HPTLC-DPPH esej je razvijen u cilju identifikacije antioksidativnih supstanci, dok je antimikrobna aktivnost ispitivana HPTLC-direktnom bioautografijom prema bakterijskim linijama *Escherichia coli* and *Bacillus subtilis*. *Nakon derivatizacije reagensom vanilin - sumporna kiselin, HPTLC hromatogram pokazuje prisustvo šest zona sa* hR_F vrednostima 5, 8, 12, 48, 78 i 89. Nakon bioautografske analize, jedinjenje sa potencijalnom antioksidativnom i antimikrobnom aktivnošću je detektovano kao žuta zona na ljubičastoj pozadini na hR_F vrednosti 78. Bioaktivna zona je ekstrahovana sa HPTLC ploče, rastvorena u acetonu i nakon toga analizirana primenom *LTQ XL ion trap MS. Pozitivan i negativan oblik jonizacije pokazuju pikove koji ogdovaraju eikozapentaenoinskoj i arahidonskoj kiselini. Dobijeni rezultati su u saglasnosti sa studijom Shin-a i koautora, koji su pokazali da antimikrobna aktivnost potiče od masnih kiselina kao što je eikozapentaenoinska kiselina*.

Bioprofiling of *Saccharina japonica* extracts by planar chromatography linked with bioassays

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The brown algae *Saccharina japonica* (J.E. Areschoug) C.E. Lane, C. Mayes, Druehl & G.W. Saunders, (syn. *Laminaria japonica*) is the most commonly consumed seaweed in northeast Asia. *S. japonica* is proven to be a rich sources of polysaccharides, fatty acids, proteins, dietary fibers and different secondary metabolites. Bioactive compounds from *S. japonica* exhibit various biological activities.The aim of the current study was to identify metabolites from different *S. japonica* extracts with potential antioxidant and antimicrobial bioactivity using a new, fast, and high throughput bioautography *technique* in combination with UPLC-*LTQ XL ion trap MS.* Five cultivars from *S. japonica* collected from a private farm in *Deokjeok* Island, South Korea were extracted with methanol, and the obtained extracts were analyzed by high-performance thin-layer chromatography (HPTLC). HPTLC-DPPH was performed to identify potential antioxidant compounds, while the antibacterial activity was leveraged by HPTLC-directed bioautography against *Escherichia coli* and *Bacillus subtilis* strains. After derivatization with vanillin-sulphuric acid reagent the HPTLC chromatogram showed the presence of six distinct spots with hR_F values at 5, 8, 12, 48, 78 and 89. Applying the bioautographic assays the spot at hR_F 78 revealed a significant inhibitory zone against *E. coli* and *B. subtilis* as well as for DPPH detected as yellow bands against purple background suggesting antioxidant and antimicrobial activities. The bioactive band was scraped off from the HPTLC plate, dissolved in acetone, and analyzed using *LTQ XL ion trap MS. Both positive and negative ion modes showed signals characteristic for* eicosapentaenoic and arachidonic acids. These results are in agreement with Shin et al., who reported about the antimicrobial activity of eicosapentaenoic acid from seaweed.

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Functionalization of yogurts with *Agaricus bisporus* extracts microencapsulated through the spray-drying technique

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The extensive use of synthetic additives by the food industry, some of them recognized as carcinogenic substances, has alerted consumers towards the need of adopting healthier habits. Thus, their appetence for functional foods, i.e. foods promoting positive effects on health in addition to their basic nutritional purposes, is progressively increasing. Moreover the food industry has been under high pressure due to legislation restrictions concerning the use of some of these artificial additives.

Mushroom extracts contain bioactive compounds potentially useful to functionalize foodstuffs. In fact, functional foods are integrating the daily diet of consumers and are gaining prominence worldwide. *Agaricus bisporus* is the species with the highest consumption worldwide, showing a great potential to be used to enrich food matrices, mainly due to its high amount of ergosterol. In the present work, alcoholic extracts of *A. bisporus* were studied for their bioactivity and viability as functional ingredients in a food product with high water content (yogurt). Extracts were microencapsulated by spray-drying (to improve their stability and hydrophilicity), using maltodextrin crosslinked with citric acid as the encapsulating material. The effect of thermal treatment (after atomization) on crosslinking and bioactivity of the produced microspheres was tested. The incorporation of free and thermally untreated forms resulted in yogurts with higher initial antioxidant activity (EC_{50} values: 214 and 272 mg/mL) that decreased after 7 days (EC_{50} values: 248 and 314 mg/mL). Contrarily, thermally treated microencapsulated extracts showed higher antioxidant activity after the same period (EC_{50} values, 0 days: 106 mg/mL; 7 days: 48.7 mg/mL), in result of an effective protection provided by microencapsulation with crosslinked maltodextrin and citric acid. Functionalized yogurts showed an overall maintenance of nutritional properties.

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Sadržaj fenolnih jedinjenja i antioksidativna aktivnost dve vrste roda *Asplenium* u različitim fazama životnog ciklusa

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Paprati su kroz istoriju smatrane značajnim izvorom lekovitih sirovina, hranljivih materija i vlakana. I pored toga, one su nedovoljno istražene u fitohemijskom smislu, a naročito haploidni gametofit koji se odlikuje krhkom građom i mikroskopskim dimenzijama, što otežava prikupljanje dovoljne količine biljnog materijala za hemijske analize. S ciljem da se opravda etnofarmakološi značaj paprati iz roda *Asplenium*, ovo istraživanje je fokusirano na karakterizacijufenolnih jedinjenja i analizu antioksidativnih svojstava sporofita i gametofita vrsta *Asplenium adiantum-nigrum* L. i *A. ruta-muraria* L., koje su široko rasprostranjene u Evropi. Metanolni ekstrakti gametofita i sporofita (listova, rizoma i korenova) su podvrgnuti UHPLC/DAD/(−)HESI-MS/MS analizi, nakon čega je utvrđena njihova antioksidativna aktivnost (ABTS i DPPH test).

Sastav fenolnih jedinjenja i antioksidativna aktivnost analiziranih vrsta ukazuju na species-specifične profile koji su uslovljeni fazom životnog ciklusa paprati. Identifikovana fenolna jedinjenja pripadaju klasama fenolnih kiselina (hidroksibenzoične i hidroksicimetne kiseline), flavonoidima (flavan-3-oli, flavonoli), i ksantonima. Sporofiti *A. adiantum-nigrum* su bogat izvor ksantona (mangiferina i mangiferin glikozida), koji predstavljaju potentne bioaktivne agense. Pored ksantona, gametofiti ove vrste sadrže značajne količine flavan-3-ola (epigalokatehin i epigalokatehin galat). Flavan-3-oli su prepoznati kao dominantna fenolna jedinjenja u sporofitima (galokatehin galat i epigalokatehin galat) i gametofitima (galokatehin i katehin) kod vrste *A. ruta-muraria*. Izražena antioksidativna aktivnost ekstrakata rizoma *A. adiantum-nigrum* i listova *A. ruta-muraria* može se pripisati visokom sadržaju ksantona i flavan-3-ola. Rezultati ukazuju na veliki antioksidativni potencijal ove dve vrste, čime je podržana njihova upotreba u tradicionalnoj medicini.

Phenolics content and antioxidant activity of two *Asplenium* species: life cycle-specific patterns

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Historically, ferns have been an important source of drugs, food, and fibers. Nevertheless, very few works have been done on their phytochemical characterization. Moreover, the haploid gametophyte phase of ferns has, probably due to the fragile structure, microscopic dimensions, and difficult collection, only rarely been the subject of phytochemical investigations. With the aim to support the ethnopharmacological importance of *Asplenium* species, the present work focuses on evaluating the phenolic content and antioxidant properties of sporophytes and gametophytes of *Asplenium adiantum-nigrum* L. and *A. ruta-muraria* L, two fern species widely distributed in Europe. Methanol extracts of gametophytes and sporophytes (fronds, rhizomes and roots) were subjected to UHPLC/DAD/(−)HESI-MS/MS analysis, and further to the evaluation of their scavenging capacities against $ABTS^{\bullet+}$ and $DPPH^{\bullet}$.

Phenolics content and antioxidant activity of analyzed *Asplenium* species showed species-specific and life cycle-specific patterns. Identified phenolic compounds belong to the classes of phenolic acids (hydroxybenzoic and hydroxycynnamic acids), flavonoids (flavan-3-ols, flavonols), and xanthones. Sporophytes of *A. adiantum-nigrum* are especially rich in xanthones (mangiferin and mangiferin glycoside), potent bioactive compounds. Besides xanthones, gametophytes contain significant amounts of flavan-3-ols (epigallocatechin and epigallocatechin gallate). Flavan-3-ols are also recognized as the major phenolic compounds in both *A. ruta-muraria* sporophytes (gallocatechin gallate and epigallocatechin gallate) and gametophytes (gallocatechin and catechin). The excellent antioxidant activity of *A. adiantum-nigrum* rhizomes and *A. ruta-muraria* fronds, against both DPPH and ABTS radicals, could be ascribed to the high content of xanthones and flavan-3-ols, respectively. The results of the present study candidate these two fern species as potent antioxidant agents, thus supporting their traditional use.

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Izbor metode za određivanje sadržaja dijetetskih suplemenata

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U radu je određivan sadržaj vitamina C i minerala Ca u dijetetskim suplementima uz pomoć klasične analitičke metode (volumetrije) i instrumentalnih metoda (konduktometrije i potenciometrije). Cilj istraživanja je bio da se uporede rezultati dobijeni klasičnom i instrumentalnom analizom dijetetskih suplemenata. U volumetrijskoj analizi za određivanje kalcijuma korištena je metoda kompleksometrije uz upotrebu mureksida kao indikatora, a vitamin C je određivan jodometrijski uz upotrebu skroba kao indikatora. Od instrumentalnih metoda konduktometrijska metoda je bila metoda izbora za određivanje vitamina C, a potenciometrijska metoda uz upotrebu Ca jon slektivne elektrode (JSE) je korištena za određivanje prisustva i sadržaja kalcijumovih jona. Za uzorke su uzeti dijeteski suplementi na bazi vitamina C i minerala Ca koji se mogu kupiti u slobodnoj prodaji. Primjenom metode titracije vrijednost *recovery* vrijednosti za sadržaj vitamina C se kretala u intervalu od 95,24 do 99,64 %, a za kalcijum od 95,11% do 99,80%. Procjena sadržaja vitamina C u konduktometrijskoj metodi određena je metodom kalibracione krive i dobijeni su sledeće *recovery* vrijendosti 95,4 – 99,5%, dok se upotrebom JSE *recovery* vrijednost kretala u intervalu od 97.5 – 105%. Sve dobijene vrijednosti bile su u skladu sa sadržajem koji je deklarisan od strane proizvođača. Jedino odstupanje koje se javilo je bilo kod jednog uzorka Ca dijetetskog suplementa uz primjenu JSE metode. Nakon izvršenih analiza zaključeno je da oba pristupa daju dobre i pouzdane rezultate. Instrumentalne metode su brže, s tim da je potrebno da se vodi računa o ometajućim faktorima, odnosno, jonima koji mogu dovesti do inteferencije i umanjiti osjetljivost elektrode, što nije slučaj kod volumetrijskih metoda.

Method analysis choice for content determination of dietary supplements

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The content of vitamin C and content of calcium mineral in dietary supplements were determined by classical analytical method (volumetry) and instrumental methods (conductometry and potentiometry). The aim of this study was to compare the results obtained by these two proposed approach in order to evaluate which method gives more reliable results. In the volumetric analysis for calcium determination, complexometry was used, with murexide as an indicator, while vitamin C was determined by iodometry using starch as an indicator. From instrumental methods, the conductometric method was the method of choice for the determination of vitamin C, and the potentiometric method, with Ca ion selective electrode (ISE), was used to determine the presence and content of calcium ions in dietary samples. All the samples of dietary supplements were obtained from local pharmacy stores. By using the titration method, the recovery value for vitamin C content ranged from 95.24 up to 99.64%, and for calcium from 95.11% to 99.80%. Estimation of the content of vitamin C by the conductometric method was determined by the calibration curve, with following recovery value: 95.4 to 99.5%. The use of ISE provide recovery value for calcium content was in the range of 97.5-105%. All the values obtained, both, for vitamin C and calcium, were in accordance with the content declared by the manufacturer. Only deviation that occurred was in case of one Ca dietary supplement with the use of the ISE method. After performed analysis, it was concluded that both approaches provide good and reliable results. Instrumental methods proved to be faster, but very sensitive to some interfering ions, which was not a case in volumetric approach.

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Sadržaj NaCl u mekim sirevima - aspekt bezbednost i zdravlje ljudi

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Kao jedna od najstarijih namirnica, sir zauzima važno mesto u ishrani ljudi zbog svoje hranljive vrednosti. U Republici Srbiji sirevi se proizvode industrijski, ali značajna količina se proizvodi u malim zanatskim pogonima i individualnim domaćinstvima. Na tržištu zelenih pijaca svakodnevo su prisutni sirevi proizvedeni na tardicionalan način od sirovog, ili kuvanog kravljeg mleka. Koagulacija se postiže dodavanjem sirila, bez komercijalnih starter kultura. Budući da se značajna količina mekih sireva proizvodi od sirovog mleka u skladu sa tradicijom, postoji mogućnost da sa mlekom u sir dospeju patogeni mikroorganizmi. So, natrijum hlorid (NaCl) doprinosi slanom ukusu i antimikrobnom delovanju u siru, ali visok sadržaj soli može da ima negativan efekat na zdravlje ljudi. Cilj ovog rada je bio da se odredi sadržaj NaCl u sirevima prisutnim na zelenim pijacam u Beogradu i da se ispita bezbednost u pogledu prisustva patogenih bakterija: *Listeria monocytogenes*, *Salmonella* spp. i koagulaza pozitivnih stafilokoka. Ispitano je ukupno 100 uzoraka sireva tradicionalno proizvedenih u individualnim domaćinstvima. Sadržaj NaCl je bio manje od 0, 01 do 2,54% u sirevima proizvedenim od sirovog mleka i manje od 0,01 do 3, 66% u sirevima od kuvanog mleka. Ni u jednom uzorku sira nisu dokazane *L. monocytogenes* i *Salmonella* spp. Koagulaza pozitivne stafilokoke su dokazane u 26 (26%) uzoraka sira i broj se kretao od 2 to 5.60 log cfu/g. Sadržaj NaCl u mekim sirevima u Srbiji omogućava unos manji od dnevne doze, koju preporučuje WHO (World Health Organization), ali je pogodovao rastu koagulaza pozitivnih stafilokoka. Sirevi u kojim je broj koagulaza pozitivnih stafilokoka bio veći od 5 log cfu/g mogu da predstavljaju rizik po zdravlje, ako je enterotoksin prisutan u dovoljnoj količini da izazove intoksikaciju konzumenta.

Sodium chloride content in soft cheeses with respect to food safety and public health

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Abstract. As one of the oldest food products, cheese takes an important place in human diets due to its nutritional value. In Serbia, cheeses are produced industrially, but significant proportions are produced in small-scale plants and in individual artisanal households. At green markets, cheeses daily present are produced from raw or cooked cow's milk in a traditional manner in households. The coagulation is achieved by addition of rennet, without addition of any commercial starter cultures. Since significant quantity of soft cheeses is produced from raw milk in accordance with tradition, there is a possibility the pathogenic microorganisms pass into cheese from raw milk. Salt (NaCl) contributes the salty taste and an antimicrobial effect to cheese, but too high a salt intake can have negative effects on human health. The aim of this research was to determine the NaCl content in cheeses available at Belgrade's green markets and to assess their safety with regard to the presence of pathogenic bacteria: *Listeria monocytogenes*, *Salmonella* spp. and coagulase-positive staphylococci. Altogether, 100 cheeses traditionally produced in individual artisanal households were studied. The NaCl content ranged from less than 0. 01 to 2. 54% in raw milk cheeses and less than 0.01 to 3.66% in heat-processed milk cheeses. *L. monocytogenes* and *Salmonella* spp. were not detected in the examined cheeses. Coagulase-positive staphylococci were detected in 26 (26%) of cheeses, with numbers ranging from 2 to 5.60 log cfu/g. The NaCl content in Serbian soft cheeses would provide a lower dose than that recommended by WHO for daily intake, but it was favourable for growth of coagulase-positive staphylococci. The raw milk cheeses in which the number of coagulase-positive staphylococci exceeded more than 5 log cfu/g could be a risk to human health if enterotoxin is present in amounts sufficient to cause intoxication of consumers.

Samonikla jestiva makromiceta *Pleurotus ostreatus* (Jacq.)P. Kumm sa teritorije Srbije: potencijalni kandidat za funkcionalnu hranu

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Interesovanje za povezanost lošeg načina ishrane i etiologije i razvoja različitih oboljenja ljudi dovelo je do porasta broja naučnih studija koje se bave mogućnostima konzumiranja određene hrane kao leka. Faktori koji tome doprinose uključuju brz napredak nauke i tehnologije, kao i povećanje svesti potrošača da kvalitetna ishrana koristi zdravlju u čemu funkcionalna hrana zauzima važno mesto. Samonikla bukovača *P. ostreatus* se tradicionalno koristi kao hrana, pa je zbog toga izabrana za detaljnu hemijsku karakterizaciju (profil nutrijenata i odabranih metabolita). Pored toga, procenjena je i sposobnost metanolnog ekstrakta bazidiokarpa ove gljive da inhibira *in vitro* rast odabranih patogenih mikroorganizama u cilju procene funkcionalnih svojstava koja mogu doprineti zdravlju korisnika. Dobijeni rezultati su pokazali da su ugljeni hidrati dominantni nutrijenti, a za njima slede proteini i masti. Od prostih šećera, trehaloza je prisutna u znatnoj količini, dok su glukoza i fruktoza prisutne u manjoj meri. Zahvaljujući niskoj energetskoj vrednosti, plodonosna tela bukovače predstavljaju zdravu, niskokaloričnu hranu koja može biti preporučena za svakodnevno konzumiranje. Analiza metabolita je pokazala prisustvo α-tokoferola, oksalne, jabučne, limunske, fumarne kao i *p*-hidroksibenzoeve kiseline. Rezultati antibakterijske aktivnosti metanolnog ekstrakta ukazali su njegovo moćno inhibitorno delovanje na rast osam vrsta bakterija, među kojima je *Pseudomonas aeruginosa* bila najosetljivija. Uzevši u obzir dobijene rezultate analize nutrijenata i energetske vrednosti, prisustvo različitih metabolita (fenolnih i organskih kiselina, kao i tokoferola) i antibakterijsku aktivnost, bukovača se može smatrati kandidatom za funkcionalnu hranu ili izvorom funkcionalnih sastojaka koji će biti korišćeni za razvoj novih, obogaćenih prehrambenih proizvoda.

Wild growing edible mushroom *Pleurotus ostreatus* (Jacq.)P. Kumm from Serbia: a potential candidate for functional food

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Renewed interest on relationship between poor nutrition and etiology and the development of various diseases affecting mankind has led to the increased number of scientific studies dealing with the consumption of certain food as medicine. Factors that contribute to this include rapid advances in science and technology and raising awareness of consumers in obtaining good health through quality diet wherein functional foods occupy an important place. Since renowned wild growing Oyster mushroom has a long tradition of use as a food, herein, we reported a detailed chemical profile regarding nutrient and selected metabolite profile. In addition, we evaluated the ability of methanolic extract obtained from mushroom basidiocarps to reduce *in vitro* growth of selected pathogenic microorganisms in order to assess functional properties of the mushroom that can provide health benefits for the consumers. Obtained results indicate carbohydrates were the most abundant compounds, followed by proteins and fat. Free sugar trehalose was present in considerable amount, unlike glucose and fructose. With low energy value, fruiting bodies of wild growing Oyster mushroom represent a healthy, low-calorie food, recommended for use on a daily basis. As for selected metabolite analyses, results revealed the presence of α-tocopherol, oxalic, malic, citric, fumaric and *p*-hydroxybenzoic acid. Results of antibacterial activity revealed potent activity against eight species of bacteria, among which *Pseudomonas aeruginosa* was the most susceptible to the activity of methanolic extract. Overall, proximate composition and energy value, as well as the presence of various metabolites (phenolic and organic acids as well as tocopherols) and antibacterial activity, indicate that Oyster mushroom may be a candidate for functional food or a source of functional ingredients used for the development of new, enriched food products.

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Bioactive compounds of the wild edible mushroom *Laetiporus sulphureus* (Bull.) Murrill. Antioxidant, antifungal and antibacterial properties

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Laetiporus sulphureus is an edible wood-rooting basidiomycete. The proximate composition, total phenol antioxidant capacity and antimicrobial activities of different extracts of *L. sulphureus* were determined. Different extraction methodologies, including high energy techniques, were employed and their effect was examined on the activity of the extracts. Optimum extraction methodologies (classical and ultrasound-assisted) provided one fraction containing neutral and polar lipids and the other fraction containing fungal carotenoids and pigments. Fatty acid analysis indicated a predominant level of polyunsaturated fatty acids followed by saturated and mono-unsaturated fatty acids. Both the aqueous methanolic and water extracts contained higher TPC and showed better antioxidant capacity than the ethanolic extract. Irrespective of the type of extraction applied, *L. sulphureus* showed good antimicrobial activity against all the tested bacteria and fungi, being in some cases stronger than the used antibiotics and mycotics. Therefore, this edible mushroom could be considered as a positive candidate to be utilised by the food industry, not only for obtaining bioactive compounds to be used as natural antioxidants/antimicrobial agents, but possibly also for its nutritional value and health benefits.

BKH15 / FQS15 U/O

Antimikrobna svojstva ekstrakata čage (*Inonotus obliquus*)

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Čaga (*Inonotus obliquus*) predstavlja jedan od najinteresantnijih izvora biološki aktivnih supstanci sa širokim spektrom vrednih komponenata. Cilj ovog rada bilo je ispitivanje antimikrobnih svojstava dve grupe ekstrakata čage – nativnih ekstrakata (vodeni ekstrakt – WE, alkalni ekstrakt – AE i etanolni ekstrakt – EE) i hemijski modifikovanih ekstrakata (prečišćeni ekstrakt – PE, poboljšan metilacijom – ME i acetilacijom – AcE). Efekti ovih ekstrakata su testirani na sedam patogenih bakterijskih sojeva i na jedan patogeni kvasac. Ispitivane su minimalna inhibitorna koncentracija (MIC), minimalna baktericidna koncentracija (MBC) i minimalna fungicidna koncentracija (MFC). Svi ekstrakti čage su pokazali značajnu inhibitornu aktivnost ka svim patogenima. ME i WE su pokazali baktericidnu aktivnost ka svim vrstama. Acetilacija i metilacija su snizile MIC vrednosti. Najbolji ekstrakt je ME, koji je pokazao najbolja svojstva sa svim MIC vrednostima ispod 1 mg/ml i njegova kinetika inhibicije je dodatno ispitivana. Za kinetiku su odabrane koncentracije ekstrakta od 1 mg/ml i 0,03 mg/ml. Ovi rezultati ukazuju da čaga može predstavljati izvor za dobijanje novih i efektivnih antimikrobnih supstanci.

Antimicrobial properties of Chaga extracts (*Inonotus obliquus*)

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Chaga mushroom (*Inonotus obliquus*) is among the most interesting sources of biologically active substances, with a broad spectrum of valuable compounds. The aim of this study was to examine antimicrobial properties of two groups of Chaga extracts – native extracts (water extract – WE, alkali extract – AE and ethanolic extract – EE) and chemically modified extracts (purified extract – PE, improved by methylation – ME and acetylation – AcE). The effects of these extracts were tested against seven pathogenic bacterial strains and one pathogenic yeast. The minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC) and minimum fungicidal concentration (MFC) were examined. All Chaga extracts showed significant inhibitory activity against all pathogens. ME and WE showed bactericidal activity against all species. Acetylation and methylation lowered MIC values. The most potent extract was ME, which showed best properties with all MIC values under 1 mg/ml and its kinetics of inhibition was additionally tested. For kinetics, concentrations of 1 mg/ml and 0,03 mg/ml of the extracts were selected. This results may indicate that Chaga could be a possible source to obtain new and effective antimicrobial substances.

Amaranthus caudatus L. as a source of betacyanins with coloring and antimicrobial properties

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Amaranthus caudatus L. is a plant belonging to the Amaranthaceae family, and is a very interesting crop, since it resists drought, heat, and pests, and adapts readily to new environments. The visual appearance of this plant is a bright red-violet, being betacyanins the compounds responsible for the color, and several bioactivities. Therefore, and despite being considered a good source of nutrients with high quality proteins, vitamins, minerals and bioactive molecules, such as phenolic compounds, *A. caudatus* can also be commercially exploited as a source of natural colorants. In the last decade, and due to the growing demand of consumers, natural matrices have been used to search natural colorant alternatives, in order to replace the artificial counterparts, which have been revealed some toxic effects. Betacyanins are natural colorants and have been used in the food industry, not only because of the high colouring power, but also due to recognized bioactive properties, such as antioxidant and antimicrobial, among others. Thus, the objective of this work was to obtain an extract rich in betacyanins to be used as food coloring agents, offering an alternative source of these coloring compounds, but at the same time conferring bioactive properties. A dynamic maceration extraction was carried out, being the extracts characterized by HPLC-DAD-ESI/MS regarding betacyanins' composition. The antibacterial activity was evaluated against a panel of four Gram-positive and five Gram-negative bacteria, and the absence of cytotoxicity was confirmed in a porcine liver primary culture. By the chromatographic analysis it was possible to identify four compounds, being amaranthine (171 ± 1 mg/g extract) and isomaranthine (38 ± 1 mg/g) the two major compounds, and betanin (1.6 ± 0.1 mg/g) and isobetanin (1.3 ± 0.1 mg/g) the minor compounds. The extract presented minimum growth inhibitory concentrations (MICs) ranging from 20-10 mg/mL, with no cytotoxicity. After such promising results, this plant can be a viable alternative to obtain natural colorant ingredients.

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Alternative sources of n-3 fatty acids from plant origin

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N-3 fatty acids are considered essential for human health, since they are associated with beneficial effects against many diseases of modern world. The most common dietary sources of n-3 fatty acids are fishes such as salmon and sardines among others, which are also incriminated with high heavy metals content. Flax or linseed is the most widely known plant source of n-3 fatty acids and is the main ingredient of food supplements. The aim of the present study was to evaluate seeds and seed oils of purslane as alternative sources of n-3 fatty acids. For this purpose, purslane seeds, oils from seeds extracted with three methods (screw press methods with or without a cooler), and seed presscakes were evaluated in terms of fatty acids composition and cytotoxicity. For comparison purposes, three commercial linseed oils, one cucurbit oil and one luffa oil were also analyzed in terms of fatty acids composition and cytotoxicity against various human tumor cell lines. The results of the study showed that linseed oils were abundant in α-linolenic acid (65.62%-71-90%), followed by linoleic and oleic acids (12.87%-17.98% and 6.43%-7.09%, respectively), while n6/n3 and PUFA/SFA ratios were lower than 4.0 and higher than 0.45, respectively. In contrast, cucurbit and luffa oils have very low amount of α-linolenic acid, since they contained mostly linoleic, oleic, palmitic and stearic acid, which resulted in very high values of n6/n3 ratios. The main detected fatty acids in purslane seed oils were α-linolenic and linoleic in amounts that depended on the extraction method. Seeds and seed presscakes also contained high amounts of α-linolenic acid and linoleic acids; however, extraction method affected fatty acids composition and values of n6/n3 and PUFA/SFA ratios. Finally, luffa oil showed the highest cytotoxicity against HeLa and NCI-H460 tumor cell lines, followed by cucurbit and one of the tested linseed oils. In conclusion, purslane seeds and seed oils could be considered as alternative n-3 fatty acids, while they have a balanced fatty acids composition and show moderate cytotoxicity against specific tumor cell lines.

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Masno-kiselinski sastav lipida ulja semenki internacionalnih i autohtonih sorti grožđa

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Korišćenje grožđa u vinskoj industriji vodi ka akumulaciji velikih količina semenki kao sporednih proizvoda. Koštice grožđa su bogat izvor masnih kiselina, među kojima su dominantne polinezasićene masne kiseline. Cilj ovog rada je bio identifikacija, kvantifikacija i poređenje masno-kiselinskih profila prisutnih u semenkama sedam različitih internacionalnih i autohtonih sorti grožđa. Pokazano je da semenke grožđa sadrže značajne količine nezasićenih masnih kiselina, naročito linolnu kiselinu, čiji se sadržaj kretao od 61,15%-83,47%. Najviši udeo linolne kiseline je detektovan u sortama grožđa Hamburg, Rizling Italijanski i Tamjanika. Oleinska kiselina najviše doprinosi sadržaju mononezasićenih masnih kiselina, dok je stearinska kiselina najzastupljenija zasićena masna kiselina u svim analiziranim uzorcima. U sorti Prokupac registrovan je najviši sadržaj obe masne kiseline. Ostale identifikovane masne kiseline su bile prisutne u tragovima.
Ključne reči: semenke grožđa, polinezasićene masne kiseline, zasićene masne kiseline, linolna masna kiselina

Fatty acid composition of lipids of international and autochthonous grape seed varieties

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Using grapes in the winemaking industry leads to accumulation of large quantities of seed by-product. Grape seed is a rich source of fatty acids among which dominate polyunsaturated fatty acids. So, the aim of this work was to identify, quantify and compare fatty acid profile presented in seed of seven different international and autochthonous grape varieties. It has been shown that grape seed contains significant quantities of unsaturated fatty acids, especially linoleic fatty acids, whose content ranged from 61,15%-83,47%. The highest concentration of linoleic acid was detected in grape varieties Hamburg, Riesling Italian and Tamjanika. Oleic acid most contributed to the content of monounsaturated fatty acids, while the stearic acid was the most abundant saturated fatty acid in all analyzed samples. Both fatty acids were registered in the highest amounts in variety Prokupac. Other identified fatty acids were present in traces.
Key words: grape seed, polyunsaturated fatty acid, saturated fatty acid, linoleic fatty acid

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Hemijski sastav karotenoida i tokola u masnom ulju iz semena autohtone sorte grožđa - tamjanike (*Vitis vinifera* L.) i njegova antimikrobna aktivnost

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Masno ulje iz semenki grožđa (*Vitis vinifera* L.) sadrži bioaktivna jedinjenja kao što su fitosteroli, tokoferoli, tokotrienoli, flavonoidi i fenolne kiseline. Ova jedinjenja poseduju širok spektar bioloških aktivnosti, koja doprinose blagotvornim učincima ulja.

Ulje iz semena tamjanike, autohtone vrste grožđa testirane u ovom radu, dobijeno je ekstrakcijom na 60°C u toku 6h uz pomoć Soxhlet aparata. HPLC/DAD analiza je korišćena za utvrđivanje sastava karotenoida, dok je za određivanje sastava tokola korišćena HPLC/FC metodologija. Antimikrobna aktivnost testirana je mikrodicionom metodom na 6 sojeva bakterija i 4 soja *Candida albicans*. Određena je i antibiofilm aktivnost masnog ulja.

Rezultati su pokazali da je masno ulje iz semena tamjanike bogat izvor tokoferola (8.03 µmol/100 g ulja) i tokotrienola (90.66 µmol/100 g ulja), sa ukupnim sadržajem vitamina E od 98.69 µmol/100 g ulja. Od flavonoida je detektovan i kvantifikovan luteolin (0.15 µmol/100 g ulja). U antimikrobnim testovima kao najrezistentnije vrste bakterija su se pokazale *Micrococcus flavus* i *Escherichia coli* (MIK 15.4 µL/mL, MBK 30,8 µL/mL). Ostali sojevi bakterija su pokazali istu osetljivost na testirano ulje (MIK 7.8 µL/mL). Rast svih sojeva *Candida albicans* je inhibiran na koncentraciji od 11.5 µL/mL, dok je masno ulje fungicidnu aktivnost ispoljilo pri koncentraciji od 23 µL/mL. Ulje je pokazalo i antibiofilm aktivnost na *C. albicans* pri testiranim subinhibitornim koncentracijama.

Ovo istraživanje je pokazalo da je masno ulje, dobijeno iz semena autohtone sorte grožđa –tamjanike, izvor tokoferola i tokotrienola, kao i dobar izvor luteolina. Masno ulje je takođe ispoljilo umerenu antimikrobnu i antibifilm aktivnost.

Chemical composition of carotenoids and tocols in fatty oil from the seeds of autochtonus grape variety - tamjanika (*Vitis vinifera* L.) and its antimicrobial activity

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Grape (*Vitis vinifera* L.) seed oil contains bioactive compounds such as phytosterols, tocopherols, tocotrienols, flavonoids and phenolic acids. These compounds possess a wide range of biological activities.

Tamjanika seed oil, autochtonous grape variety tested in this paper, was obtained by extraction at 60°C for 6h with Soxhlet extractor. HPLC/DAD analysis was used to determine the composition of carotenoids, while HPLC/FC methodology was used to determine the composition of tocols. Antimicrobial activity was tested by microdilution method on 6 strains of bacteria and 4 strains of *Candida albicans*. Antibiofilm activity of fatty oil was also determined.

The results showed that fatty oil from tamjanika seeds is a rich source of tocopherols (8.03 µmol/100 g of oil) and tocotrienols (90.66 µmol/100 g of oil) with a total vitamin E content of 98.69 µmol/100 g of oil. From flavonoids luteolin was detected and quantified (0.15 µmol/100 g of oil). *Micrococcus flavus* and *Escherichia coli* (MIC 15.4 µL/mL, MBC 30.8 µL/mL) were highlighted as the most resistant species of bacteria in antimicrobial assays. Other strains of bacteria showed the same susceptibility to the tested oil (MIC 7.8 µL/mL). Growth of all *Candida albicans* strains was inhibited at concentration of 11.5 µL/mL, while fatty oil exhibited fungicidal activity at concentration of 23 µL/mL. Antibiofilm activity of oil towards *C. albicans* was also demonstrated at the tested subinhibitory concentrations.

This research has shown that fatty oil, obtained from the seeds of autochthonous grape variety, was a source of tocopherols and tocotrienols, as well as a good source of lutein. Fatty oil also exhibited moderate antimicrobial and antibiofilm activity.

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Zlatno seme Kvinoje (*Chenopodium quinoa*): Nutritivne osobine i lekoviti efekti

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Kvinoja (*Chenopodium quinoa* Willd.) je pseudocerealija koja potiče iz Južne Amerike gde je gajena duže od 7000 godina. Ime „zlatno seme“ kvinoja je dobila zbog svojih izuzetnih nutritivnih i lekovitih karakteristika. Seme kvinoje ima značajnu nutritivnu vrednost zahvaljujući visokom sadržaju proteina i esencijalnih amino kiselina, minerala, vitamina, esencijalnih masnih kiselina kao i antioksidanasa (polifenola i flavonoida) koji su, zbog svojih antimikrobnih, antiinflamatornih, antitumorskih i antikancerogenih osobina, od posebnog značaja za zdravlje ljudi. Seme kvinoje ne sadrži gluten i zbog toga se preporučuje celijakičnim pacijentima. Takođe, kvinoja se može gajiti u onim agro-ekološkim uslovima u kojima abiotički stresni faktori ograničavaju efikasnu poljoprivrednu proizvodnju. Različite sorte kvinoje se gaje ili testiraju u 95 zemalja. Međutim, nisu zastupljena u Srbiji čija se poljoprivredna proizvodnja i prehrambena industrija suočavaju sa problemima izazvanim sve više izraženim nepovoljnih klimatskim faktorima. U radu su prikazani rezultati testiranja mogućnosti gajenja kvinoje u Srbiji. Rezultati dobijeni u uslovima suvog ratarenja i sa dva lokaliteta su potvrdili da se kvinoja može uspešno gajiti i da su nutritivne, zdravstvene i tehnološke osobine proizvedenog semena bile veoma dobre. Sadržaj proteina i esencijalnih amino kiselina je bio veći nego kod žitarica, dok su sadržaj minerala i ulja bili takođe značajni, kao i sadržaj slobodnih i vezanih fenolnih kiselina, flavonoida i antioksidativni kapacitet. Očišćena semena kvinoje (da se ukloni saponini) u procentu do 20% su bila iskorišćena za pravljenje više vrsta hleba obogaćenog kvinojom čije su hemijske i senzorne karakteristike bile veoma dobre. Ovi rezultati su pokazali da se u Srbiji kvinoja može gajiti kao alternativna kultura i ukazali na mogućnost da se u budućnosti od kvinoje prave prehrambeni proizvodi sa povoljnim nutritivnim i lekovitim svojstvima.

Golden Grain of Quinoa (*Chenopodium quinoa)*: Nutritional characteristics and Health effects

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Quinoa (*Chenopodium quinoa* Willd.) is a pseudocereal which originates from the South America where it was grown more than 7000 years. The name “golden grain” was done to quinoa because of its exceptional nutritional and health characteristics. High nutritional value of quinoa seeds is due to the high protein content and essential amino acids, minerals, vitamins, essential fatty acids as well as antioxidants (polyphenols and flavonoids), which, due to their antimicrobial, anti-inflammatory, anti-tumor and anti-cancer properties, are of special importance for human health. The quinoa seed does not contain gluten and it is recommended for celiac disease patients. Also, quinoa can be cultivated agro-ecological conditions in which abiotic stresses limit effective agricultural production.
Currently, various quinoa varieties are being cultivated or tested in 95 countries. However, they are new for Serbia, whose agricultural production and food industry are facing problems caused by the increasingly unfavorable climatic factors. In the presented study the results of testing the possibility of growing quinoa in Serbia are shown. The results obtained under rain-fed conditions and from two sites confirmed that quinoa can be successfully cultivated and that the nutritive, natural and technological properties of the seed produced were very good. Protein and essential amino acids were higher than in cereals, with significant mineral and oil contents, as well as the contents of free and bound phenolic acids, flavonoids and antioxidant capacity. Dehulled quinoa seed (to remove saponins) up to 20% was used to make several types of bread enriched with quinoa with very good chemical and sensory characteristics. These results have shown that in Serbia quinoa could be cultivate as an alternative culture and pointed to the possibility that other quinoa food products with favorable nutritional and health properties can be made in the future.

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Ruj – magično drvo

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Cotinus coggygria Scop., je biljna vrsta iz familije Anacardiaceae, čije se brojne vrste koriste u ishrani i tradicionalnoj medicini za lečenje raznih bolesti. *C. coggygria* poznata kao “dimno drvo”, a u našim krajevima poznata kao ruj ili rujevina, je ukrasna biljka u obliku žbuna ili drveta i široko je korišćena u narodnoj medicini. Lišće i drvo ruja su korišćeni u XV veku za bojenje tkanina, a u novije vreme za bojenje jakih alkoholnih pića, rakija. Hemijski sastav ove biljne vrste je detaljno proučavan, kako isparljive komponente etarskih ulja lišća, tako i hemijski sastav ekstrakata lišća i drveta. Ekstrakti ruja i čista jedinjenja pokazala su antioksidativnu, antifungalnu, antivirusnu, hepatoprotektivnu i antiinflamantornu aktivnost, a etarska ulja antibakterijsku i antifungalnu.
Etarsko ulje lišća ruja uglavnom sadrži monoterpenske ugljovodonike, a glavne komponente su limonen, (*Z*) i (*E*)-*β*-ocimen, *α*-pinen i terpinolen. Ulje je pokazalo značajnu antimikrobnu aktivnost posebno ka gram pozitivnim bakterijama i na mikromicetu *Candida albicans*.
U ekstraktima lišća i drveta ruja mogu se naći nekoliko tipova jedinjenja – flavoni, fenolne kiseline, triterpeni i dr. Iz metilen-hloridno/metanolnog ekstrakta drveta ruja izolovano je najviše flavonoidnih (poznatih) jedinjenja sa karakterističnim skeletom, ali i dva nova sekundarna metabolita, jedan auron i jedan auronolignan koji predstavlja novu potklasu flavonolignana.

Ruj – magic tree

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Cotinus coggygria Scop. is a species of the family Anacardiaceae with numerous species used in nutrition and traditional folk medicine for the treatment of several human diseases. *C. coggygria* commonly known as ‘‘smoke tree’’, is an ornamental plant often used in traditional medicine. Leaves and bark were used in XV century for coloring textile and recently, for coloring strong alcoholic drinks - rakija. Chemical composition of this species was investigated in details, volatiles from the essential oils obtained from leaves as well as extracts of leaves and heartwood of this plant. Extracts and isolated compounds exhibited numerous activities namely antioxidative, antibacterial, antifungal, antiviral, anticancer, hepatoprotective and anti-inflammatory activities, while essential oils exhibited antibacterial and antifungal activities.
Essential oil obtained from leaves possess mostly monoterpenes and major constituents are limonene, (*Z*) and (*E*)-*β*-ocimene, *α*-pinene and terpinolene. Essential oil exhibited significant antimicrobial activity against Gram positive bacteria and towards *Candida albicans* from fungi.
In the extracts of leaves and heartwood of *C. coggygria* few types of compounds was found – flavones, phenolic acids, triterpenes, etc. From the methylene chloride/methanol extract of *C. coggygria* heartwood the most isolated compounds were flavones (known) with characteristic skeleton, but also two new secondary metabolites, one aurone and one auronolignan representing new subclass of flavonolignans.

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Cvetni polen i polen medonosnih pčela kao potencijalni dodatak hrani- sadašnjost i perspektiva

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Polen je izuzetno bogat hranljivim supstancama- proteinima, ugljenim hidratima, lipidima, mineralima, vitaminima kao i brojnim sekundarnim metabolitima biljaka a pre svega polifenolnim jedinjenjima. Zbog toga je moguća primena polena kao potencijalnog dodatka u ishrani. Brojna istraživanja su pokazala da polen ima izuzetno veliku nutritivnu vrednost i to pre svega kao dobar izvor određenih makro- i/ili mikroelemenata, a posebno gvožđa i cinka. Na hemijski sastav i kvalitet polena najveći uticaj ima njegovo botaničko, geografsko poreklo i mikrobiološka ispravnost koji se moraju utvrditi pre bilo kakve dalje analize i primene. Prisustvo brojnih polifenolnih jedinjenja čini polen dobrim antioksidansom. Najnovija istraživanja su pokazala i da polen ima dobra tehno-funkcionalna svojstva i to pre svega veoma izražena anti-peniva svojstva i visok kapacitet vezivanja ulja, zbog čega bi se mogao primeniti u formulaciji prehrambenih proizvoda gde su ovakve karakteristike poželjne. Takođe, dodatak polena u određene prehrambene proizvode (poput biskvita) pozitivno je uticao na njihove senzorne karakteristike.
Ključne reči: cvetni polen, polen medonosnih pčela, dodatak hrani

Floral pollen and bee pollen as potential food supplement-present and perspectives

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Pollen is a good source of important nutrients- proteins, carbohydrates, lipids, minerals, vitamins as well as a quite number of secondary plant metabolites such as different polyphenolics. It makes pollen as a potentially good food supplement. Numerous studies have shown that pollen possessed high nutritional value, primarily regarding to high content of certain macro- and/or microelements, especially iron and zinc. The chemical composition and quality of the pollen are influenced by its botanical and geographical origin. Also, microbiological quality is very important and must be determined before any further analysis or pollen application. Presence of different polyphenolics in pollen provides good antioxidative properties. Recently, good techno-functional properties of pollen have been approved, above all very pronounced anti-foaming properties and excellent oil absorbtion capacity, which could be used in the formulation of food products where such characteristics are desirable. Also, the addition of pollen to certain food products (such as biscuit) has positively influenced their sensory characteristics.
Key words: floral pollen, bee pollen, food supplement

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Faktori hazarda u proizvodnji bezbedne hrane za životinje i ljude

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Hrana za životinje predstavlja materiju koja uneta peroralnim putem u organizam, a posle resorpcije oslobođenih sastojaka iz digestivnog trakta, obezbeđuje energiju, gradivni materijal i pomaže odvijanje fizioloških i biohemijskih procesa. U oblasti proizvodnje hrane kako za životinje, tako i za ljude dominantna su dva kriterijuma, ekonomičnost i proizvodnja visoko vrednih, ali i bezbednih namirnica animalnog porekla. Bezbednost hrane za životinje uključuje aspekt neškodljivosti za ljude i životinje. Postoje biološke, hemijske i fizičke opasnosti značajne za bezbednost hrane za životinje koje mogu da se prenesu preko hrane za životinje i samih životinja do hrane za ljude (meso, mleko, jaja). Dioksin i jedinjenja slična dioksinu su sporedni produkti različitih industrijskih procesa. Spadaju u najtoksičnije ekološke zagađivače i kancerogene supstance. Najopasniji dioksin je tetrahlordibenzo-*p*-dioxin-TCDD. Dioksini se raznose vazduhom i talože u vodi i zemljištu odakle ulaze u lanac ishrane, kao i u tkiva svih živih bića. Čovek u svoj organizam unosi oko 80% dioksina preko hrane animalnog porekla. Zakonska regulativa u Srbiji ne dozvoljava prisustvo dioksina u hrani bez obzira da li je namenjena ishrani ljudi ili životinja. Pored dioksina, veliku pažnju stručne i naučne javnosti privlače i mikotoksini. To su ektracelularni metaboliti plesni koji imaju kancerogeno, teratogeno i hepatotoksično dejstvo na ljude i životinje. Glavni put unošenja mikotoksina je ingestijom kontaminirane hrane, a poseban problem predstavlja mogućnost da se u organizmu životinje koja je uzimala kontaminiranu hranu mogu naći rezidue (mikotoksini i njihovi metaboliti) u različitim koncentracijama, tako da može doći do ispoljavanja štetnih efekata i kod ljudi. Aflatoksini su produkti sekundarnog metabolizma plesni *Aspergillus flavus* i *Aspergillus parasiticus*. Opasnost predstavlja činjenica da se aflatoksini biotransformišu u jetri, a da se jedan od njegovih metabolita aflatoksin M izlučuje putem mleka.

Hazards in production of safe feed and food

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Feed are substances that, when being ingested and absorbed in gastrointestinal tract of the animal, provide energy and building material for the body and help physiological and biochemical processes to be carried out. Two criteria are crucial in the field of feed and food production: cost effectiveness and the production of safe product with high biological value. Feed safety includes the aspect of harmlessness for humans and animals. There are biological, chemical and physical hazards that are important for the feed safety. Those hazards can be indirectly transferred to humans through the feed and food-producing animals to food of animal origin (meat and meat products, milk and dairy products, eggs). Dioxin and dioxin-like substances are byproducts of different industrial processes. They are one of the most poisonous pollutants and carcinogenic substances. The most poisonous dioxin is tetrachlordibenzo-*p*-dioxin-TCDD. Dioxins are being transferred throughout air and precipitate in the soil and bodies of water, from where they can enter either feed and food chain, and consequentially the tissues of animals and humans. About 80% of dioxins are resorbed in human body from the food. Serbian legislative does not allow presence of dioxins nor in the feed or food. In addition to dioxin, mycotoxins also attract attention of the expert and scientific public. Mycotoxins are extracellular metabolites of molds which are cancerogenic, teratogenic and hepatotoxic. Mycotoxins are mainly ingested with the contaminated food. Moreover, residues of mycotoxins in different concentrations can be found in the food produced from animals that were fed with the contaminated feed. Aflatoxins are secondary metabolism's products of *Aspergillus flavus* and *Aspergillus parasiticus*. Aflatoxins are being biotransformed in the liver and one of the byproducts of biotransformation, aflatoxin M, is being excreted with milk.

EFEKAT ISTRAŽIVANJA NA PROIZVODNJU TREŠNJE U SEVERNOM KLIMATU

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Proizvodnja trešnje u svetu odvija se na otvorenom polju, gde su stabla posađena u redovima. U Norveškoj trešnja se gaji u područjima sa povoljnim lokalnim klmatskim uslovima sve do 60° severne geografske širine. Berba trešanja u Norveškoj odvija se najkasnije u odnosu na sve ostale evropske zemlje. Gaje se sorte koje su stvorene u drugim zemljama, u sistemima guste sadnje, koje sazrevaju tokom jula i avgusta dajući plodove visokog kvaliteta. U poslednjih deset godina mnogi proizvođači su inicirali projekte koji su bili finansirani od strane države i/ili privatnih kompanija Projekti su izučavali podloge, nove sorte, gustu sadnju, proizvodnju u zaštićenom prostoru, navodnjavanje, đubrenje, primenu bioregulatora, ocenu kvaliteta ploda, čuvanje plodova i integrisani način zaštite biljaka. NIBIO iz Ulensvanga rukovodi nacionalnim programom o testitranju novih sorti, proučavajući preko 60 sorti trešnje iz različitih svetskih oplemenjivačkih programa. Osobine u koje spadaju veličina ploda, čvrstoća ploda, pucanje pokožice, visoki i redovni prinosi i ukus su neke koje se posebno analiziraju. Najčešći način proizvodnje trešnje u Norveškoj je više-komorni sistemi visokog tunela sa pratećom folijom u cilju zaštite plodova protiv kiše. Pokriveni visoki tuneli ne samo da štite plodove od pucanja pokožice, već takođe omogućuju kontrolu rasta i plodonošenja zasada. Zapravo, proizvodnja trešnje u visokim tunelima daje veće prinose krupnijih plodova nego što to omogućuje proizvodnja trešnje na otvorenom, ali su i ulaganja i troškovi mnogo veći. Još jedan noviji sistem proizvodnje, je gajenje trešanja u malim saksijama u staklenicima. Staklenik daje mogućnost kontrole temeparturnog režima, i na taj način da se predvidi i kontroliše sazrevanje plodova. Preliminarni rezultati pokazuju da je potencijal prinosa mnogo veći nego na otvorenom polju sa mnogo krupnijim plodovima. Rezultati ovog eksperimenta su predstavljeni velikim privatnim kompanijama, dok su naučni radovi sa ovom temom objavljeni u naučnim časopisima i saopšteni na naučnim skupovima.

IMPACTS OF RESEARCH ON SWEET CHERRY PRODUCTION IN A NORTHERN CLIMATE

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Sweet cherry production worldwide is grown in the open land, where trees are arranged in single rows. Sweet cherries can be grown in Norway in areas with suitable local climatic conditions up to 60°N. Norwegian sweet cherries are harvested later than all other European countries. International cultivars, grown under high-density systems, ripen from July through August, producing high quality fruits. Many grower-initiated research projects financed by public funds and by the fruit industries have been conducted over past decades. Topics researched include rootstock and cultivar evaluation, high density planting systems, covering systems, fertigation, bioregulators, fruit quality assessment, postharvest storage and integrated pest management. Nibio Ullensvang is in charge of the national fruit cultivar-testing program having more than 60 sweet cherry cultivars from different breeding programs worldwide under evaluation.. Important parameters like fruit size, fruit firmness, fruit-cracking incidence, high and precocious yielding, fruit firmness and flavour are evaluated. The most common systems in Norway are multibay high tunnel systems and retractable rain covers. Covered orchard tunnel systems offer not only the advantage of rain exclusion but also allow additional manipulation of the environment, tree growth and fruiting. In general, sweet cherry high tunnel production gives increased yields of larger fruit than in the open land, but investment costs are higher. One more advanced way of producing sweet cherries is to grow the trees in small pots in greenhouses. A greenhouse gives opportunity to control the temperature regime and in that way program the maturity of the fruits. Preliminary results show that the yield potential is much higher than in the open land with larger fruits. Results from the experiments conducted are disseminated to the fruit industry and through peer refereed scientific papers and presentations at international conferences.

OH2 /FCS2 U/O

HEMIJSKA SVOJSTVA PLODA SORTI BOROVNICE (*Vaccinium corymbosum*) GAJENIH U INTEGRALNOJ I ORGANSKOJ PROIZVODNjI

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Cilj ovog rada bio je da se uporede hemijska svojstva tri sorte borovnice (‘*Bluecrop*’, ‘*Duke*’ i ‘*Nui*’), koje su gajene u integralnoj i organskoj proizvodnji, da bi se dala preporuka koja od ispitivanih sorti borovnice bi bila najpodobnija za gajenje na organski način. Proizvodnja i organskih i itegralnih borovnica bila je izvedena u selu Pambukovica, pa su agroklimatski i zemljišni uslovi bili skoro isti. Rastvorljiva suva materija varirala je u intervalu od 9,83% (‘*Duke*’, integralna proizvodnja) do 12,63% (‘*Bluecrop*’, organska), dok je sadržaj ukupnih kiselina bio u interval od 0,28% (‘*Duke*’, integralna proizvodnja) do 0,56% (‘*Nui*’, organska proizvodnja). Sve tri sorte imale su veće vrednosti ukupnih polifenola, ukupnih antocijana i ukupnog antioksidativnog kapaciteta u organskoj proizvodnji u odnosu na iste sorte u integralnoj proizvodnji. Najzastupljeniji šećeri u plodu borovnice bili su glukoza i fruktoza čije su vrednosti bile znatno više kod organski proizvidednih plodova u odnosu na integralno proizvedene plodove. Jedino je sadžaj glukoze kod sorte ‘*Duke*’ bio približno isti kod ova dva načina proizvodnje. Na osnovu visokih vrednosti antioksidativnih komponenti, šećera i sadržaja suve materije, može se zaključiti da su sve tri sorte ispoljile bolje rezultate u organskoj proizvodnji, pa se zato mogu preporučiti za gajenje na ovaj način.

CHEMICAL CHARACTERISATION OF BLUEBERRY (*Vaccinium corymbosum*) FRUIT OBTAINED FROM INTEGRAL AND ORGANIC PRODUCTION

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The aim of this study was to compare chemical properties of three blueberry cultivars (‘*Bluecrop*’, ‘*Duke*’ and ‘*Nui*’), which are grown in integrated and organic production, in order to give a recommendation which cultivar would be the most suitable for growing organically. Production of organic and integrated blueberries was in the village of Pambukovica, so the agro-climatic and soil conditions were almost the same. The soluble solid content varied in the range from 9.83% (‘*Duke*’, integral production) to 12.63% (‘*Bluecrop*’, organic production), while total acidity was from 0.28% (‘*Duke*’, integral production) to 0.56% (‘*Nui*’, organic production). All three cultivars had higher values of total polyphenol content, total anthocyanin content and total antioxidant capacity when produced organically. The most common sugars in the blueberry fruits were glucose and fructose, which levels were higher in organically produced fruits. Only the content of glucose in cultivar ‘*Duke*’ had similar level of glucose in both fruits originated from organic and integral production. Based on high antioxidative components, sugars and soluble solid content can be concluded that all three blueberry cultivars showed better results in organic production and can recommended for cultivation in this way.

UNIFood Conference
Predavanje i usmene prezentacije u okviru sekcija/Lecture and oral presentation within sections
ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OH3 / FCS3 U/O

Hemijski sastav biomase prosa i soje gajenih u sistemu kombinovanih useva

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Sistemi regenerativne poljoprivrede podrazumevaju različite sisteme gajenja useva i upotrebe đubriva sa ciljem pozitivnog uticaja na biogenost zemljišta i kvalitet useva. Postavljen je ogled različitih sistema kombinovanih useva prosa i soje: naizmenični redovi i trake (2 reda soje + 2 reda prosa; 2 reda soje + 4 reda prosa), kao i čistih useva, kako bi se pratile promene u koncentraciji rastvorljivih proteina, rastvorljivih fenola kao i fitinskog i neorganskog fosfora u zelenoj biomasi. Paralelno je ispitivan i uticaj mikrobiološkog đubriva Coveron (kombinacija *Glomus* sp. i *Trichoderma* sp.) na date parametre. Rezultati pokazuju da postoji značajna razlika u koncentraciji ispitivanih analita između različitih kombinacija gajenja. Posebno se izdvojila kombinacija useva gajenih u trakama tretirana mikrobiološkim đubrivom, koja pozitivno utiče na povećanje koncentracije analita, a kao i na prinos zelene biomase. Ovaj način gajenja se čini pogodnim za povećanje produktivnosti i kvaliteta biomase za stočnu ishranu.

Chemical composition of biomass of proso millet and soybean grown in intercropping system

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Regenerative agriculture implies different systems of crop growing and fertilizers usage, with the aim of positively influencing on soil biogenity and crop quality. An overview of various intercropping systems of proso millet and soybean is given: alternating rows and strips (2 rows of soybean + 2 rows of proso millet; 2 rows of soybean + 4 rows of proso millet), as well as sole crops in order to monitor changes in concentration of soluble proteins, soluble phenols as well as phytic and inorganic phosphorus in green biomass. In parallel, the influence of bio-fertilizer Coveron (combination of *Glomus* sp. and *Trichoderma* sp.) on the given parameters was also investigated. The results show significant difference in concentration of the tested analytes between various experimental combinations. In particular, a combination of crops grown in strips with bio-fertilizers has been singled out, which positively affect concentration of analytes and, at the same time, the green biomass yield. This method seems to be suitable for increasing the productivity and quality of biomass for animal feed.

OH4 / FCS4 U/O

Елементални састав: студија клонске селекције сорте мерло

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Циљ овог рада био је да се испита елементални састав одабраних узорака (грожђе, лишће и вино) клонских кандидата сорте мерло (022, 025 и 029), недавно развијених на подручју Републике Србије. Од 2016. године сва три клонска кандидата у процедури су да буду признати као нови клонови дате сорте винове лозе у нашој држави. Како њихове саднице нису заражене вирусима, представљају добар основ за производњу сертификованог (безвирусног) садног материјала. Добијени резултати биће приказани и детаљно продискутовани на самом скупу.

Elemental composition: the case study of Merlot clonal selection

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The aim of this study was to investigate the elemental composition of the selected samples (grapes, leaves and wine) of Merlot clone candidates (Nos. 022, 025 and 029), recently developed in the Republic of Serbia. Since 2016 all three clone candidates have been under the procedure to be recognised as new grapevine clones of this variety in our country. As virus-free, their seedlings represent good platform for the production of certified (virus-free) planting material. The obtained results will be presented and discussed in detail at the conference.

UNIFood Conference
Predavanje i usmene prezentacije u okviru sekcija/Lecture and oral presentation within sections
ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OH5 / FCS5 U/O

Exploitation of *Origanum dictamnus* oil for the preservation of fresh produce against *Botrytis cinerea*

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Postharvest losses of fruit and vegetables due to opportunistic microorganisms are considerable, with chemical applications to be of great consumer concerns regarding food safety. Alternative sanitizers are seeking, with natural compounds such as essential oils (EOs) to achieve scientific and consumer's interest for the preservation of fresh produce. In the present study, the efficacy of dittany (*Origanum dictamnus* L.) essential oil for the control of *Botrytis cinerea*, a common postharvest pathogen of three economically important vegetables, tomato, pepper and eggplant was examined. Pathogen development (vegetative or reproductive phase) in culture medium or in fruits was evaluated after treatment with dittany EO (0, 50, 100, 250 ppm) *in vitro* and *in situ* when stored at 12 °C and 95% RH during or following exposure to EO volatiles. *In vitro*, fungal development was completely inhibited by the application of 100 or 250 ppm of EO volatiles. In inoculated fruits, the application of 50 ppm EO resulted in suppressed disease development by reduced lesion growth and fungal sporulation, where increasing EO concentration led to greater effects. Pre-exposure of the three fruits to volatiles, before fungal inoculation, revealed reduced lesion growth, indicating that dittany EO probably caused induced resistance of fruits against the pathogen. Moreover, EO application did not affect quality-related characteristics of fruits in general, while skin lightness and pulp lightness of eggplant fruits were improved under the presence of dittany EO volatiles. Overall, the results suggest that dittany EO volatiles may be considered as an alternative food preservative treatment, significantly reducing or eliminating *B. cinerea* infection during fruit storage.

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OH6 / FCS6 U/O

Dizajniranje inovativnih funkcionalnih starter kultura za proizvodnju mlečnih fermentisanih proizvoda

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S obzirom na povećani interes potrošača za hranom sa dodatnom vrednošću, potreba za razvojem novih mlečnih proizvoda koji pozitivno utiču na zdravlje je sve više prepoznata u prehrambenoj industriji. Stoga je cilj ovog rada bio selekcija prethodno okarakterisanih prirodnih izolata bakterija mlečne kiseline (BMK) sa izuzetnim fiziološkim, tehnološkim i probiotičkim osobinama i dizajniranje mešanih starter kultura za proizvodnju različitih mlečnih proizvoda na maloj industrijskoj skali pod kontrolisanim uslovima: (1) krem sira (*Lactococcus lactis* BGTRK4-21 i *Lactobacillus plantarum* BGGO7-29), (2) belog sira (*L. lactis* subsp. *lactis* BGVL2-8 i *Lb. plantarum* BGVL2a-18), (3) jogurta (*Streptococcus thermophilus* BGKMJ1-36 i *Lb. delbrueckii* subsp. *bulgaricus* BGVLJ1-21) i (4) fermentisane pavlake (*L. lactis* BGTRK4-21, *L. lactis* subsp. *lactis* biovar. diacetilactis BGTRK10-2, *L. lactis* subsp. *cremoris* BGTRM1-22 i *Leuconostoc mesenteroides* subsp. *cremoris* BGTRS1 -2). Rezultati ovog rada sugerišu uspešno korišćenje novih starter kultura za proizvodnju mlečnih proizvoda sa autentičnom aromom i teksturom tradicionalnih mlečnih proizvoda pod kontrolisanim uslovima i sa istim reproducibilnim kvalitetom. Osim toga, odabrani prirodni izolati BMK imaju dobru proteolitičku aktivnost nakon koje nastaje jedinstveni profil peptida, ispoljavaju antimikrobnu i imunomodulatornu aktivnost i produkuju specifična aromatična jedinjenja važna za ukus finalnog proizvoda. Na kraju, možemo da zaključimo da prirodni izolati BMK imaju veliki potencijal za primenu u industrijskoj proizvodnji mlečnih proizvoda sa očuvanim tradicionalnim senzornim karakteristikama domaćih sireva. S obzirom da odabrani prirodni izolati BMK pokazuju i probiotički potencijal, proizvedeni sirevi se mogu se smatrati funkcionalnom hranom.

Designing of innovative functional starter cultures for production of added-value dairy products

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Due to increased consumers’ interest for added value foods, development of novel health-promoting dairy products became increasingly recognised in food industry. In that order, well-characterised natural isolates of lactic acid bacteria (LAB) with prominent physiological, technological and probiotic properties were selected for defined mixed starter culture design for production of various types of cheeses at small industrial scale under the controlled conditions: (1) cream cheese (*Lactococcus lactis* BGTRK4-21 and *Lactobacillus plantarum* BGGO7-29), (2) white brined cheese (*L. lactis* subsp. *lactis* BGVL2-8 and *Lb. plantarum* BGVL2a-18), (3) yoghurt (*Streptococcus thermophilus* BGKMJ1-36 and *Lb. delbrueckii* subsp. *bulgaricus* BGVLJ1-21) and (4) sour cream (*L. lactis* BGTRK4-21, *L. lactis* subsp. *lactis* biovar. diacetylactis BGTRK10-2, *L. lactis* subsp. *cremoris* BGTRM1-22 and *Leuconostoc mesenteroides* subsp. *cremoris* BGTRS1-2). The results of small scale industrial production suggested promising use of these starter cultures for production of novel dairy products with authentic aroma and texture of the traditional dairy products under controlled conditions and with the same reproducible quality. In addition, the selected natural LAB isolates have good proteolytic activity deliberating unique pattern of peptides, exhibit antimicrobial and immunomodulatory activity and produce specific aromogenic compounds important for the flavor of the final product. In conclusion, this study represents the potential of autochthonous LAB application to ensure traditional texture and flavour of industrially produced cheeses. As some of the selected autochthonous LAB strains for cheese production are attributed as potential probiotics, produced cheeses could be considered as functional food.

OH7 / FCS7 U/O

Senzorska svojstva kvaliteta pralina punjenih medom sa dodatkom voća i lekovitog bilja

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Praline su proizvod sa dugom tradicijom čija se kompleksnost oblika i sastava neprekidno povećava zbog stalne potražnje za novim ukusima, teksturama i funkcionalnim sastojcima. Cilj ovog istraživanja je bio da se proizvedu ručno pravljene praline od crne čokolade (72% kakao-delova) sa punjenjem od livadskog meda u koji su dodate komponente poput jezgrastog i kandiranog voća (pistaći, brusnice, kora pomorandže, indijski orah) i lekovitog bilja (menta, lavanda), da se ispita njihov hemijski sastav, kao i senzorna svojstva kvaliteta tokom skladištenja (1., 30., 60. i 90. dana). Po višem sadržaju masti i proteina izdvojili su se uzorci sa dodatkom indijskog oraha (masti 40%, proteini 11%) i pistaća (masti 38,65% i proteini 13,2%). Najviši sadržaj ukupnih šećera imali su uzorci sa dodatkom kore pomorandže (72,2%) i sušene brusnice (70,5%), zbog dodatka šećera pri postupku kandiranja ili radi očuvanja boje. U pogledu senzornog kvaliteta najbolje su ocenjeni uzorci sa dodatkom mente koji su se odlikovali jedinstvenim, osvežavajućim mirisom koji je perzistirao tokom 90 dana, kao i nepromenjenom konzistencijom i bistrinom meda. Prodor vlage i šećera u plodove brusnice i cvetove lavande učinio ih je manje suvim i prijatnijim za konzumiranje što je uslovilo poboljšanje kvaliteta, dok u slučaju pistaća omekšavanje plodova nije ocenjeno kao pozitivna pojava. Kora pomorandže, zbog sadržaja pektina, je uticala na jače želiranje meda uslovljavajući postepeno opadanje ocena. Najlošije su ocenjeni uzorci sa dodatkom indijskog oraha koji su posle 90 dana pali u kategoriju dobrog kvaliteta, zbog uočene pojave užeglosti. Može se zaključiti da se kvalitet pralina sa punjenjem od meda uz dodatak voća i lekovitog bilja može održati relativno dugo bez upotrebe aditiva, a najveća prednost ovih proizvoda ogleda se u mogućnosti kombinovanja nutritivno vrednih i funkcionalnih sastojaka punjenja sa osvedočenim zdravstvenim i senzornim benefitima čokolade.

Sensory properties of pralines with honey filling and addition of fruits and medicinal herbs

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Pralines are products with a long tradition whose complexity of shapes and compositions is constantly increasing due to the continual demand for the new tastes, textural sensations and functional ingredients. The aim of this study was to produce hand-made dark chocolate pralines (72% cocoa solids) filled with meadow honey with added ingredients such as nuts and candied fruits (pistachios, cranberries, orange peels, cashew) and medicinal herbs (mint, lavender), as well as to examine the sensory properties of final products during storage (on 1st, 30th, 60th and 90th day). Samples containing pistachios and cashew stood out by increased amount of protein (13,2% and 11%, respectively) and fat (38,65% and 40%, respectively). The highest content of total sugars was determined in the samples with orange peel (72,2%) and dried cranberries (70,5%), probably because of use of additional sugar in the panning process or for the color preservation. In terms of sensory quality, the best rated were samples with addition of menta which exhibited unique, refreshing odor that persisted for 90 days, as well as unchanged consistency and clearness of honey. The penetration of moisture and sugar into the cranberries and lavender flowers made them less dry and more pleasant to consume, which caused quality improvement, while in the case of pistachios, softening of the fruit was not considered a positive phenomenon. Orange peel, due to the content of pectin, has affected the stronger gelation of honey, resulting in a gradual decline of scores. The samples with lowest scores were those with addition of cashew, which after 90 days fell into the category of good quality mostly because of the noticed rancidity. It can be concluded that the quality of pralines with honey filling and addition of fruits and medicinal herbs can be maintained relatively long without the use of additives and the biggest advantage of these products is the ability to combine nutritious and functional ingredients with a proven health and sensory benefits of chocolate.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OH8 / FCS8 U/O

Using Response Surface Methodology to Maximize Heat Assisted Extraction of Rosmarinic Acid in Three Medicinal and Aromatic Plants

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The increasing awareness of consumers, which prefer food with natural additives, shifted the industry to pursue natural counterparts for food additives. Among them, one preservative, E392, is obtained from the rosemary plant (*Rosmarinus officinalis* L.), with its main preserving molecule being rosmarinic acid (RA). Given its expensive and costly extraction, alternative plants should be pursued. In this work, heat assisted extraction with varying hydroalcoholic mixtures as solvent (*S*, ethanol proportion in % from 0 to 100), temperatures (*T*, from 25 to 85ºC) and times (*t*, from 20 to 120 min) were tested in rosemary, basil (*Ocimum basilicum* L.) and sage (*Salvia officinalis* L.). A response surface methodology was used to define the optimum extraction conditions to maximize the RA content, using a circumscribed central composite design of three variables with five levels. The extraction results were expressed in three response format values (Y): Y1, mg of RA (determined through -HPLC-DAD) per g of leave (L) dry matter (mg RA/g L dw), specifically used to analyse the content of the plants in RA; Y2, mg of RA obtained in the extracted dried weight residue (R; mg RA/g R) to measure the purity of R; and Y3 in g R/g P dw, which provides information regarding the extraction yield in R. For rosemary, the optimal global conditions were at 87.18±6.97 min, 85.00±8.50ºC, and 39.09±0.78% of ethanol, producing 23.28±0.70 mg RA/g L dw (Y1), 82.59±4.13 mg RA/g R (Y2), and 0.31±0.02 g R/g P dw (Y3). For basil, these were at 98.44±3.94 min, 85.00±0.85ºC, and 44.91±3.59% of ethanol, producing 28.61±1.14 mg RA/g L dw (Y1), 111.74±11.17 mg RA/g R (Y2), and 0.32±0.04 g R/g P dw (Y3). And for sage at 120.00±6.00 min, 85.00±1.70ºC, and 47.25±0.47% of ethanol, producing 28.895±2.3 mg RA/g L dw (Y1), 126.63±5.07 mg RA/g R (Y2), and 0.33±0.03 g R/g P dw (Y3).
In brief, the obtained results show the potential of several plants as a source of RA, with potential uses in the food industry and others.

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OH9 / FCS9 U/O

KARAKTERIZACIJA TOFUA PRIPREMLJENOG SA DODATKOM INULINA

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Inulin pruža brojne nutritivne i zdravstvene prednosti kao tehno-funkcionalni aditiv u prehrambenoj industriji. Uglavnom se koristi u pekarskoj, mesnoj, mlečnoj i konditorskoj industriji. U literaturi dostupnoj autorima, nema podataka o njegovoj upotrebi u proizvodnji tofua. Tofu je pripremljen hidrotermičkim kuvanjem (visoka temperatura i pritisak/kratko vreme) uz himozin-pepsinski kaoagulant i inulin kao funkionalni aditiv. Rezultati pokazuju da je proizveden tofu gel u čijoj mreži su čvrsto vezane glikoproteinske podjedinice (γ-, β-konglicinin i lektin). Dobijeni tofu karakteriše visok sadržaj ukupnih (41,76-55,65%) i rastvorljivih (15,53-36,75%) proteina, dobra proteinska ekstraktibilnost (37,19-68,56%) i iskoristljivost ukupnih (69,39-52,23%) i rastvorljivih (50,25-84,79%) proteina, kao i mala rezidualna tripsin-inhibitorska aktivnost (3,08-5,71%). Inulin povećava čvrstinu gela (6,23-8,89 N/cm^2), doprinosi uniformnosti gela i ne povećava energetsku vrednost tofua (18,82-18,31 kJ/g suve materije). Može se zaključiti da se tofu sa dodatkom inulina može koristiti kao namirnica sa potencijalno promotivnim efektom po ljudsko zravlje.

CHARACTERIZATION OF TOFU PREPARED WITH THE ADDITION OF INULIN

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Inulin provides numerous nutritional and health benefits to humans, and is used in food industry as additive. It is mainly used in baking, meat, dairy and confectionery industry. No data on its use in firm tofu production is available. Tofu was prepared by pilot plant processing method involving high temperature/pressure and chymosin-pepsin rennet with the addition of inulin as functional ingredient. The results indicated that tofu glycoprotein subunits of γ-, β-conglycinin and lectin were firmly bound to the matrix of the gel. Tofu showed high total (41.76-55.65%) and soluble (15.53-36.75%) proteins content, good protein extractability (37.19-68.56%) and total protein (69.39-52.23%) and soluble protein (50.25-84.79%) recovery as well as low residual trypsin-inhibitor activity (3.08-5.71%). Inulin improved the tofu hardness (6.23-8.89 N/cm^2) and contributed to the uniform microstructure of gel, but did not increase its energy values (18.82-18.31 kJ/g fresh matter). Summarizing, the obtained tofu may be considered as a food with potential health-promoting effects.

OH10 / FCS10 U/O

UTICAJ RAZLIČITIH METODA SUŠENJA NA SENZORNA SVOJSTVA CVEKLE

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Cilj istraživanja je bio da se ispitaju efekti različitih metoda sušenja na promene u senzornom kvalitetu i prihvatljivosti sušenih kolutova cvekle. Primenjena su tri različita metoda sušenja: sušenje u struji superkritičnog CO_2 (sa i bez kuvanja u prethodnom koraku), liofilizacija i prženje u ulju. Senzorna analiza je obuhvatila deskriptivnu analizu, ispitivanje kvaliteta i testiranje potrošača. Deskriptivni podaci su obrađeni primenom uopštene Prokrust analize i analize glavnih komponenata. Ekstrahovane glavne komponente su korišćene kao prediktori u postupku višestruke linearne regresije u odnosu na ocene ukupne prihvatljivosti. Regresioni koeficijenti su podvrgnuti metodi klasterovanja pomoću K-sredina. Različiti modeli ANOVA i analiza pada srednje vrednosti ocene ukupne prihvatljivosti su takođe primenjeni na dobijene senzorne podatke.
Ocene senzornog kvaliteta unutar opsega 'vrlodobrog' kvaliteta su dobijene samo kod $scCO_2$-sušenih uzoraka koje je karakterisala tipična purpurno-crvena boja, mali stepen deformacije oblika i površine, neintenzivan miris i ukus na cveklu, izražena lomljivost i hrskavost, kao i dobra rehidracija tokom žvakanja. Ocene svih ostalih uzoraka su bile u opsegu 'dobrog' kvaliteta. Kuvanje cvekle pre sušenja je negativno uticalo na senzorni kvalitet $scCO_2$-sušenih proizvoda, prvenstveno na izgled. Oko 60% testiranih potrošača je pokazalo naklonost ka uzorcima sušenim prženjem, kao i $scCO_2$-sušenim uzorcima koji nisu bili podvrgnuti prethodnom kuvanju. Svojstva koja su najviše uticala na prihvatljivost su uglavnom bila povezana sa proizvodom koji je bio slan, pržen, hrskav, sa notama ukusa na ulje i pregorelo, odnosno sa proizvodom koji je najsličniji komercijalnom čips-proizvodu od krompira. Liofilizacija je imala negativan efekat prvenstveno na izgled i ukus proizvoda.
Senzorno ispitivanje je pokazalo da direktno sušenje u struji superkritičnog CO_2 bez prethodnog kuvanja ima značajan potencijal da bude primenjen kao alternativna metoda u proizvodnji sušene cvekle, međutim neophodno je prvo potvrditi ekonomsku opravdanost za primenu na industrijskom nivou.

Zahvalnost
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EFFECTS OF DIFFERENT DRYING METHODS ON CHANGES IN SENSORY PROPERTIES OF BEETROOT

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The aim of this study was to investigate the effects of different drying methods on changes in sensory quality and acceptance of dried ready-to-eat beetroot snacks. Three different drying methods were applied: supercritical CO_2-drying (with or without precooking step), freeze-drying and frying. Descriptive sensory analysis, sensory quality rating, and consumer acceptance testing were performed. Descriptive data were subjected to Generalized Procrustes Analysis and Principal Component Analysis. Extracted PCs were used as explanatory variables in further linear multiple regression analysis against the overall hedonic data. The regression coefficients were segmented using K-means cluster analysis. Different ANOVA models and Mean Drop analysis were also applied to obtained sensory data.
Mean overall quality scores within the range of ‘very good’ quality were found only in non-precooked $scCO_2$-dried samples which were characterized by typical magenta color, low level of shape and surface deformations, not intensive beetroot odor and flavor, pronounced brittleness and crispiness, and good rehydration during mastication. The other samples were in the range of a ‘good’ quality. Pre-cooking step before $scCO_2$-drying negatively influenced the sensory quality parameters, at the first place appearance. Around 60% of tested consumers showed a preference for the fried and non-precooked $scCO_2$-dried samples. The drivers of liking were mostly related to the characteristics of the product which was salted, fried, and crispy, with oil and overburnt flavor, i.e. to the product most similar to commercial potato chips products. Freeze-drying had negative effect primarily on appearance and flavor.
According to the sensory evaluation conducted, direct $scCO_2$-drying without pre-cooking step, showed promising potential to be used as an alternative drying method in production of dried beetroot snacks, but an economic justification is required for the industrial application at large scale.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OH11 / FCS11 U/O

Precizan farmski uzgoj u kontekstu bezbednosti hrane

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Upravljanje kontinuumom lanca hrane od farme do viljuške treba da obezbedi odgovarajući nivo zaštite potrošača (ALOP). To može da bude postignuto pomoću naučno bazirane ocene rizika koja obuhvata informacije o prevalenci i koncentraciji glavnih zoonotskih opasnosti po javno zdravlje (*Salmonella, Campylobacter, Listeria monocytogenes,* STEC) u svim fazama lanca hrane: farma-transport-klanica-prerada mesa-distribucija-maloprodaja-potrošači. S obzirom da zoonotske opasnosti mogu da kontaminiraju lanac hrane u multiplim tačkama, ocena rizika treba da obezbedi znanje o najefektivnijim kontrolnim merama koje treba tipično da budu primenjene na sinergistički način da pojavljivanje opasnosti u lancu hrane bude umanjeno. Zdrave životinje predstavljaju osnovni preduslov da bi se obezbedila bezbedna hrana. Od najveće je važnosti primena efektivnih kontrolnih mera na farmi sa ciljem redukovanja kontaminacije u narednim fazama lanca hrane. Od nedavno, postoji novi pristup koji se naziva `precizan farmski uzgoj` (PLF) koji omogućava rano otkrivanje bolesti. PLF olakšava razumevanje kako klinički znaci ili simptomi (biološki ili u ponašanju) koje životinje pokazuju mogu lako da budu uočeni u ranoj fazi, kako bi se umanjila ili sprečila pojava bolesti i stoga izbegla upotreba antibiotika; to je takođe relevatno i za dobrobit životinja imajući u vidu nedavno definisane indikatore koji ukazuju na stepen dobrobiti. PLF je baziran na filozofiji da kompletno automatizovan kontinuirani monitoring životinja omogućava farmerima da prate zdravstveni status i dobrobit životinja i da im pomogne da donose brze odluke bazirane na evidenciji kako bi se prilagodili promenama u vezi sa zahtevima za uzgoj životinja, npr. ugrađeni senzori na vratu za detekciju specifičnih parametara u ponašanju, tehnologije koje zvučnim ili vizuelnim putem omogućavaju kontinuirani monitoring ponašanja/respiratornih simptoma na farmama svinja, nanobiosenzori integrisani sa IT tehnologijama (IoT) za brzi monitoring infektivnih bolesti životinja na farmi u svakom momentu. PLF omogućava inteligentno upravljanje zdravstvenim statusom životinja uključujući sisteme za brzo uzbunjivanje kako bi se zadovoljili povećani zahtevi za animalnim proteinima i u isto vreme garantovala dobrobit i zdravstveni status životinja, buduća održivost farmske proizvodnje, kao i unapredio nivo bezbednosti hrane.

Precision livestock farming in a food safety context

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The food chain continuum from farm to fork should be managed to provide the appropriate level of consumer protection (ALOP). This can be achieved by science-based risk assessment which includes the information about prevalence and concentration of major public health hazards of zoonotic origin (*Salmonella, Campylobacter, Listeria monocytogenes,* STEC) in all modules along the food chain: farm-transport-slaughterhouse-meat procesing-distribution-retail-consumers. Since hazards can enter the food chain at multiple points, the risk assessment should be carried out to provide knowledge about the most effective control measures which should be typically applied in synergistic way to minimize the occurrence of food safety hazards in the food chain. Healthy animals are the essential precondition for obtaining safe food supply. It is of utmost importance to apply effective control measures on-farm with the aim to reduce the load of contamination in subsequent modules along the food chain. From recently, there is a new approach called Precision Livestock Farming (PLF) enabling the early disease detection system. PLF facilitates understanding how clinical signs or symptoms (either biological or behavioural) that the animals exhibit can easily be picked up at a very early stage, to limit or avoid the occurrence of diseases, hence to avoid the use of antimicrobials; this is also relevant for animal welfare, using recently defined animal-based welfare indicators. PLF is based on the philosophy that fully automated continuous monitoring of animals enables farmers to monitor the health and welfare status of their animals continuously and automatically and help them make quick and evidence-based decisions to adjust to changes in animal requirements, e.g. in-built collar sensors to detect specific behavioural parameters, sound or visual technologies in pig farms, that allow the continuous monitoring of behavioural/respiratory symptoms, nanobiosensors integrated with Internet-of-Things (IoT) technology for rapid and real-time monitoring of infections/animal diseases on farm. PLF supports intelligent management of animal health including rapid alert systems to meet the growing demand for animal proteins, while guaranteeing animal health and welfare, the future sustainability of animal farming, as well as improved food safety.

OH12 / FCS12 U/O

Uticaj različitih sistema mineralne ishrane na antioksidativni kapacitet zrna kukuruza

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Zrno kukuruza je važan izvor fito-nutritiva u ishrani ljudi i životinja. Testirana je primena različitih sistema mineralne ishrane kao što su: urea (standardno mineralno đubrivo), mikrobiološko đubrivo (Team mycoriza plus), organsko đubrivo (Fertor) i kontrola (bez đubrenja) na promene u koncentraciji rastvorljivih fenola, ukupnog glutationa, fitinske kiseline, žutog pigmenta i kapaciteta redukcije DPPH radikala u zrnu hibrida kukuruza bele, žute i crvene boje. Rezultati pokazuju da je crveno zrno kukuruza, u proseku, imalo najveću koncentraciju fenola i žutog pigmenta uz najveće vrednosti redukcije DPPH, u većini tretmana. Urea je u izvesnom stepenu uticala na povećanje fitina kod kukuruza žutog i belog zrna, kao i žutog pigmenta u žutom i crvenom kukuruzu. Najveće vrednosti fenola kod sva tri hibrida bile su zabeležene pod uticajem mikrobiološkog đubriva, glutationa kod kukuruza žutog i crvenog zrna, dok je kod hibrida žutog zrna organsko đubrivo uticalo na povećanje vrednosti redukcije DPPH, u odnosu na ostale tremane. Rezultati ukazuju da su kod belog hibrida fenoli, a u nešto manjem stepenu glutation i žuti pigment, pozitivno korelirali sa promenama DPPH, dok su kod žutog hibrida fitin i fenoli značajno korelirali sa DPPH (fitin pozitivno, a fenoli negativno). Kod crvenog hibrida korelacija je bila pozitivna između fenola i DPPH i negativna između glutationa i DPPH. Ispitivanja su pokazala da zrna kukuruza različitih boja mogu biti značajan izvor različitih antioksidanata čija se koncentracija može menjati u željenom smeru upotrebom različitih tipova đubriva, što je posebno značajno za održive sisteme gajenja.

The impact of different mineral nutrition on antioxidative capacity of maize grain

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Maize grain is important source of phytonutrients in food and feed. The application of different systems of mineral nutrition: urea (standard mineral fertilizer), bio-fertilizer (Team mycoriza plus), organic fertilizer (Fertor) and control (without fertilization) on alterations in concentration of soluble phenols, total glutathione, phytic acid, yellow pigment and DPPH reduction capacity in maize grain with white, yellow and red colour grain, were tested. Results indicate that red grain maize, on average, had the highest concentration of phenols and yellow pigment, with the highest reduction capacity of DPPH, in all treatments. Urea caused phytate increase in yellow and white grain maize, as well as yellow pigment increase in yellow and red maize to some extent. The highest values of phenols in grain of all three hybrids were gained by bio-fertilizer, and of glutathione in yellow and red grain, while at yellow grain hybrid the highest values of DPPH reduction capacity were present under the influence of organic fertilizer in comparison to other treatments. Results pointed that in white grain maize, phenols and in lesser extent glutathione and yellow pigment, positive correlated to DPPH variations, while in yellow grain hybrid phytate and phenols were correlated significantly with DPPH (phytate positive and phenols negative). In red grain hybrid correlation was positive between phenols and DPPH and negative between glutathione and DPPH. Studies signified that maize grain of different colour could present the important source of different antioxidants whose concentration could be altered by application of different type of fertilizer in desired direction, which is particularly important for sustainable agriculture.

OH13 / FCS 13 U/O

Transport lakokvarljive robe - ATP sporazum

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Transport lakokvarljive robe (uglavnom prehrambene) je vrlo složen proces naročito ako se zasniva na principima hladnog lanca (Cold Chain). Različiti ljudi i preduzeća su uključeni u transport proizvoda od tačke proizvodnje do krajnjeg kupca. Konstrukcija vozila namenjena za transport lakokvarljive robe je složena i zahteva se visoka pouzdanost svih elemenata koji su zaduženi za održavanje temperature kao i visoka otpornost na atmosferske uticaje tokom transporta. ATP sporazum predstavlja uređen sistem transporta lakokvarljive robe kao i specijalne zahteve za konstrukciju vozila (podneblje transporta, količina i vrsta robe) koje vrše transport, a primenjuje između članica potpisnica sporazuma. Prvi ATP sporazum je sačinjen 1. septembra 1970. godine

Transport of perishable foodstufs - ATP agreement

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Transport of perishable foodstufs (mostly food products) is a very complex process, especially if it based on Cold Chain principles. Various companies and people are included in transport of products from point of production to the end-buyer. Vehicle construction intended for transport of perishable foodstuffs is very complex and high reliability must be required for all systems that monitor and control required temperature, and durability to resist any atmospheric condition during the transport. ATP agreement represents organized system that defines every aspect of transport and also special requirements for vehicle construction (area of transport, volume and type of products), and it is applied between the states that ratify the treaty. First ATP agreement was signed on September 1st 1970.

OH14 / FCS14 U/O

Agro-industrijski otpad za proizvodnju mlečne kiseline i hrane za životinje

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Poslednjih godina se beleži značajan porast potražnje mlečne kiseline (MK) na svetskom tržištu usled širokog spektra primene u hemijskoj, prehrambenoj, farmaceutskoj i industriji polimera. Potražnja za MK na globalnom nivou neprestano raste prvenstveno usled rastućeg trenda primene biodegradabilnih polimera MK – polilaktida. Razvoj strategije koja bi obezbedila visoku koncentraciju i produktivnost MK fermentacijom jeftinih i lako dostupnih sirovina je jedan od najvećih izazova u proizvodnji MK.

U radu je ispitivana mogućnost proizvodnje MK na supstratu na bazi destilerijske džibre i melase, pomoću soja *Lactobacillus paracasei* NRRL B-4564 imobilisanog na prirodne nosače, kao što su repin rezanac, pivski trop i ljuska suncokreta. Stabilnost i efikasnost tri imobilisana sistema su upoređene u ponovljenoj šaržnoj fermentaciji sa recirkulacijom imobilisane biomase. Takođe, izvršena je hemijska karakterizacija nosača zaostalog nakon fermentacije, kao i analiza preživljavanja *L. paracasei* u prisustvu žučnih soli i pri niskoj pH vrednosti, u cilju procene kvaliteta čvrstog ostatka nakon fermentacije kao hraniva za životinje.

Adsorpcija *L. paracasei* ostvarena na površinu prirodnih nosača je omogućila laku separaciju bakterijske biomase iz fermentacionog medijuma i njeno efikasno ponovno korišćenje u pet uzastopnih šaržnih ciklusa. Najbolji parametri fermentacije (produktivnost od 1,48 g/L h, koncentracija od 80,10 g/L i koeficijent prinosa od 0.97 g/g) su ostvareni primenom repinog rezanca kao nosača. Analizom hemijskog sastava je pokazan zadovoljavajući kvalitet fermentisanih nosača sa aspekta primene u ishrani životinja, kao i značajno povećanje svarljivosti suve materije u odnosu na nefermentisane nosače. Ispitivanjem probiotskih osobina pokazana je visoka stopa preživljavanja *L. paracasei* pri pH vrednosti 2,5 (91%) i u prisustvu 0,3% žučnih soli (96%).

Imobilizacija *L. paracasei* na prirodne nosače predstavlja ekonomičan i održiv način kojim se ostvaruje proizvodnja MK i visokokvalitetne hrane za životinje.

Agro-industrial waste for production of lactic acid and animal feed

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Lactic acid (LA) has recently achieved considerable importance in the global market because of a wide range of applications in chemical, food, pharmaceutical and polymer industries. The world LA consumption is continually increasing, mostly due to the expansion of the application range of biodegradable polymers such as poly-lactides. Development of strategy which would provide high LA concentration and productivity in fermentation of low-cost, abundant and easy available raw materials is one of the biggest challenges of the LA industry.

In this study, distillery stillage and sugar beet molasses were used as a substrate for LA production by *Lactobacillus paracasei* NRRL B-4564 immobilized onto agro-industrial materials, such as sunflower seed hull (SSH), brewers' spent grain (BSG), and sugar beet pulp (SBP). The stability and efficiency of three immobilized systems were compared in repeated batch fermentation with immobilized biomass recirculation. Additionally, characterization of the support materials remained after fermentation and the survival of *L. paracasei* at low pH value and bovine bile solution were examined in order to assess the quality of solid part of fermentation media with immobilized biomass as animal feed.

A strong cell attachment onto supports allowed easy separation from the fermentation media and efficient biocatalyst reuse in five successive batch cycles. SBP immobilization system showed superior performance compared to BSG and SSH, achieving LA productivity of 1.48 g/L h, LA concentration of 80.10 g/L and average yield coefficient of 0.97 g/g. Regarding chemical composition, all fermented supports manifested potentially good characteristics for animal nutrition, as well as enhanced dry matter digestibility compared to unfermented materials. In addition, high survival rates of *L. paracasei* at low pH (91%) and bovine bile (96%) indicated that this strain is a good probiotic candidate.

The process could be applied as sustainable and effective strategy for co-production of LA and high-quality animal feed.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY
OH15 / FCS15 U/O

MULTIPAPRIK – Inovativni uređaj za pečenje paprike

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Paprika je veoma cenjeno povrće koje se koristi u svežem stanju za pripremu salata, za kišeljenje i za proizvodnju tradicionalnih proizvoda kao što su pečena paprika, pinđur i ajvar. Dosadašnji način pripreme pečene paprike, ajvara i pinđura podrazumeva termičku obradu paprike na metalnim pločama. Ovaj način proizvodnje iziskuje značajno angažovanje radne snage, neracionalnu potrošnju energije i nije u skladu sa savremenim ekološkim standardima. Osim toga, sorte koje nisu namenjene za pečenje kao i one nepravilnog oblika teško se mogu upotrebiti za ovu svrhu. Zahvaljujući našoj inovaciji za pečenje paprike, svi pomenuti problemi su prevaziđeni.
Osmišljen je i napravljen uređaj kojim se pečenje paprike obavlja veoma brzo i kvalitetno a plodovi se nakon termičke obrade vrlo lako ljušte. Oblik paprike više ne predstavlja problem pri njenom pečenju a angažovanje radne snage u procesu pečenja je smanjeno. Model uređaja kojim je materijalizovana ova tehnička inovacija kao energent koristi električnu energiju ali je uređaj vrlo lako prilagoditi za druge energente: drvo, drveni ugalj, pelet i plin. Produkti sagorevanja su izolovani od paprike koja se peče.
U toku jeseni 2014. godine, uređaj je korišćen za uslužno pečenje paprike za više od 80 domaćinstava. U toku naredne tri sezone ponavljano je uslužno pečenje a broj zainteresovanih domaćinstava bio je sve veći. Zadovoljni korisnici su isticali kvalitet ispečene paprike. Potrošnja energije u odnosu na dosadašnji način pečenja je manja što svrstava ovaj uređaj u grupu energetski efikasnih.
Zbog svih navedenih prednosti ovog uređaja i pretpostavke da je rešenje jedinstveno u svetu, podneta je patentna prijava. Proverom patentnih prijava na svetskom nivou, utvrđeno je da nema prijavljenih uređaja sličnih karakteristika koji se koriste za ovu svrhu.

MULTIPAPRIK – An innovative device for pepper processing

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Pepper is a highly regarded vegetable that is used as raw for salad preparation, for pickling and for the production of traditional products such as roasted peppers, pinjur (pinđur) and ajvar. The current methods for preparation of roasted peppers, ajvar and pinjur mean thermal processing of peppers on the surface of metal plates. This way of production requires engagement of significant labor force, irrational energy consumption and it is incompatible with modern ecological standards. In addition, pepper varieties which are not suitable for roasting as well as those of irregular shape can hardly be used for this purpose. Thanks to our innovation for pepper roasting, all of these problems have been overcome.
Our device makes the roasting of peppers very fast and quality after which these fruits can be easily peeled after the thermal treatment. The shape of pepper is no longer a problem for its roasting, and the workforce engagement in the roasting process is reduced. The model of the device that materializes this technical innovation uses electricity as an energy source, but can be easily adapted for other energy sources: wood, coal, charcoal, pellet and gas. The combustion products are isolated from roasting peppers.
During the autumn of 2014, the device was used for roasting of peppers then provided to more than 80 households. During the next three seasons, the same activity was repeated, and the number of interested households was growing. Satisfied users emphasized the quality of roasted peppers. Energy consumption in comparison to the previously used methods of roasting is lower, which places this device in a group of energy efficient ones.
According to all of the stated advantages of this device and the assumption that the solution is unique in the world, a patent application is filed. By verifying patent applications at world level, it has been found that there are no reported devices of similar characteristics used for this purpose.

OH16 / FCS16 U/O

Strategije socijalnog marketinga u povećanju svesti o važnosti zdrave ishrane kod potrošača

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U radu će biti predstavljena strategija socijalnog marketinga u povećanju svesti o važnosti zdrave ishrane kod potrošača. Strategije socijalnog marketinga, putem tradicionalnih i savremenih medija, društvenih mreža, unapređuju edukaciju o zdravim stilovima ishrane, kao i pravilnim izborima prehrambenih proizvoda. Istraživanja i znanja o stavovima i navikama potrošača u ishrani zahtevaju poznavanje kulturnog nasleđa i karaktera potrošača u nekom istorijskom periodu. Izbor hrane, metod korišćenja, čuvanja i serviranja smatra se kulturnim fenomenom. Neki autori smatraju da društveno okruženje stimuliše ponašanje potrošača, u cilju zdravog i kvalitetnog života. Nije uvek jednostavno uspostaviti vezu između fiziološke percepcije i reakcije potrošača. Odgovor potrošača, kada je hrana u pitanju, nije baziran samo na senzorskim osobinama proizvoda i njegovom fizičkom statusu, već je povezan i sa drugim faktorima kao što su: prethodna informisanost, iskustvo potrošača, kao i njegove navike, stavovi i verovanja. Strategije socijalnog marketinga, kroz edukaciju, usmeravaju potrošače ka adekvatnim izborima proizvoda. Danas su potrošači mnogo zahtevniji u pogledu kvaliteta i bezbednosti hrane, deklarisanja proizvoda, opredeljenosti proizvođača da primenjuje određene standarde u proizvodnji, da se pokaže kao društveno odgovorni subjekt društva u kome posluje. Celokupno ponašanje potrošača - npr. konzistentnost kupovina, preporuke drugima, rangiranje, uverenja, procene i namere – povezano je sa stavovima. Sa aspekta ponašanja potrošača stav je naučena sklonost ponašanja na dosledno prihvatljiv ili neprihvatljiv način u odnosu na određeni objekat. S obzirom na činjenicu da kompanije slede principe marketing orjentacije i posmatra potrošače, kao polaznu i finalnu tačku svojih marketinških aktivnosti, istraživanje navika i stavova potrošača u ishrani može pružiti korisna saznanja u vezi sa njihovim potrebama i željama. Kompanije svoje proizvode kreiraju tako da objedinjuju razumevanje, predviđanje i zadovoljenje navika potrošača u ishrani i koncipiranje strategija socijalnog marketinga.

Social marketing strategies in the increasing of awarrness about importance of consumers healthy nutrition

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This research will represent social marketing strategies in aim to increase consumers awareness of the importance of healthy nutrition. Social marketing strategy, through traditional media and modern media, social networks, improves education about healthy nutrition styles, as well as proper choices of food products. Research and knowledge about consumers attitude and habits requires knowledge about cultural heritage and consumer charachter in some particular historical period. The food choices, usage, way of saving and serving are considered as cultural phenomenon. According to some authors, social environment stimulates consumer behavior in order to ensure the sound of healthy and quality life. It is not always easy to establishe relationship between physiological preceptions and consumers reaction. Consumer responses, regarding food, is not just based on the sensory charachteritics of products and its physical status. It is connected with other factors such as: previous education, experiences, habits, attitudes and consumers beliefs. Social marketing strategy, through education, directs consumers, towards food choices. Today, consumers are more demanding in terms of quality and food safety, product declaration, producers commitment to apply certain standards in production and to expose as social responsible company. Overall consumer behavior, such as consistency of purchasing, recommedations to others, ranking, beliefs, estimates and intentions are associated with attitudes. From this point of consumer behavior, attitude is learned preference behavior for consistency which is acceptible or unacceptible maner in relation to particular object. Attitudes and habits make important determinations of consumer behavior and their questioning to gain information is useful for food producers, as well as strategy of social marketing. Research can provide useful information about consumers needs and wishes. The company products are created by combining understanding and satisfying consumers habits in nutrition with providing social marketing strategy.

OH17 / FCS17 U/O

Bezbednost hrane poreklom iz Srbije

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Značaj bezbednosti hrane je sveobuhvatno iskazan stavom Svetske zdravstvene organizacije: „Sa svakim zalogajem koji uzmemo, potencijalno smo izloženi bolesti usled mikrobiološke ili hemijske kontaminacije. Bezbedna hrana čuva živote!“.
Uvid u probleme bezbednosti hrane u Srbiji može se steći i na osnovu informacija sa javnog servisa Evropske Komisije za brzo uzbunjivanje za hranu i hranu za životinje. U poslednjoj deceniji zabeleženo je 107 nofitikacija za hranu poreklom iz Srbije, što je uključilo 15 kategorija hrane, najčešće voće i povrće (46,7%), žitarice i pekarske proizvode (19,6%), orašasto voće i proizvode, semenke (8,4%), slatkiše (8,4%), masti i ulja (3,7%), biljke i začine (2,8%). U pogledu identifikovanih opasnosti, patogeni organizmi su zauzeli vodeću poziciju sa 40,9%, a slede ih mikotoksini (17,3%) i industrijski kontaminanti (11,8%), dok je pojava ostalih opasnosti rangirana kako sledi: ostaci pesticida > alergeni = strana tela > nepatogeni mikroorganizmi > izmenjene osobine = biotoksini > druge opasnosti. Najčešće kombinacije su bile voće i povrće sa patogenim mikroorganizmima (norovirus 24,5%, hepatitis A 5,4%, Listeria monocitogenes, Salmonella; ukupno 31.8%) ili ostacima pesticida (nikotin, propargit, pirimetanil, azoksistrobin, boskalid, procimidon, formetanat, hlorpirifos; ukupno 5.4%), žitarice i pekarski proizvodi sa mikotoksinima (aflatoksini > deoksinivalenol > ohratoksin A, fumonizini > zearalenon; ukupno 10.9%) ili industrijskim kontaminantima (akrilamid, 6.4%), orašasto voće, proizvodi i semenke sa mikotoksinima (aflatoksini, 6.4%) i slatkiši sa patogenim mikroorganizmima (Salmonella, 3.6%). Rizik je okarakterisan kao ozbiljan u 47% slučajeva, neodlučen 37% i neozbiljan 16%. Povlačenje sa tržišta i povrat od potrošača su najčešće preduzimane akcije (20 i 19%, redom). Prikazani podaci zahtevaju aktivan stav i u Srbiji!

Safety issues in food originating from Serbia

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Importance of food safety issues is perfectly reflected with the statement of World Health Organization „With every bite one eats, one is potentially exposed to illness from either microbiological or chemical contamination. Safer food saves lives.“
Insight into food safety challenges in Serbia could be obtained using information from Rapid Alert System for Food and Feed, public service of the European Commission. In the last decade, 107 notifications were registered for food products originating from Serbia, belonging to 15 food categories, most often fruits and vegetables (46.7%), cereals and bakery products (19.6%), nuts, nut products and seeds (8.4%), confectionery (8.4%), fats and oils (3.7%), herbs and spices (2.8%). Regarding hazard categories, pathogenic micro-organisms took the lead with 40.9%, followed by mycotoxins (17.3%) and industrial contaminants (11.8%), while other hazards occurrence was ranked in the following order: pesticide residues > allergenes = foreign bodies > non pathogenic micro-organisms > adulteration/fraud = biotoxins > others. Most frequent combinations were fruits and vegetables with pathogenic micro-organisms (norovirus 24.5%, hepatitis A 5.4%, Listeria monocitogenes, Salmonella; in total 31.8%) or pesticide residues (nicotine, propargit, pyrimethanil, azoxystrobin, boscalid, procymidone, formetanate, chlorpyrifos; in total 5.4%), cereals and bakery products with mycotoxins (aflatoxins > deoxynivalenol > ochratoxin A, fumonisins > zearalenone; in total 10.9%) or industrial contaminants (acrylamide, 6.4%), nuts, nut products and seeds with mycotoxins (aflatoxins, 6.4%), and confectionery with pathogenic micro-organisms (Salmonella, 3.6%). Risk was characterized as serious in 47% of the cases, undecided 37% and not serious 16%. Withdrawal from the market and recall from the consumers were the most frequently taken actions (20 and 19%, respectively). Presented data demand an active attitude in Serbia also!

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY
OH18 / FCS18 U/O

Promocija proizvodnje i konzumiranja zdrave hrane kroz proces edukacije

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Rad je zasnovan na istraživanju mogućnosti promocije zdrave hrane u toku obrazovnog procesa na master studijama na Arhitektonskom fakultetu Univerziteta u Beogradu, kroz dva teoretska i projektno orijentisana predmeta koji su fokusirani na održivo planiranje i urbani dizajn u prirodnom okruženju. U toku školske 2016-17. i 2017-18. godine predmeti su se zasnivali na prepoznavanju i isticanju prirodnih pogodnosti područja Magliča kod Kraljeva, odnosno Vlasinskog jezera, a potom i na koncipiranju prostornih rešenja koja bi doprinela promociji zdravog načina života i zdrave ishrane. Dok je šire okruženje Magliča prepoznato kao pogodno za razvoj posebnog tipa turizma –turizma hrane, u sklopu prostornog koncepta koji podržava održivi turizam, kulturni i ruralni razvoj, šire područje Vlasinskog jezera je, u skladu sa prirodnim pogodnostima, prepoznato kao potencijal za prostorni razvoj zasnovan na specifičnim vidovima poljoprivrede.
Proizvodnja i konzumacija zdrave hrane izaziva sve veći interes u svetu, istovremeno angažujući različite profile stručnjaka i podstičući miltidisciplinarni pristup istraživanju i kreiranju novih rešenja. Polazni podsticaj proizvodnji i konzumaciji zdrave hrane vezan je za planiranje prostornog razvoja i unapredjenje ruralnih područja, te je na ovoj pretpostavci utvrdjen specifičan metodološki okvir za edukaciju na master nivou studija.

Promoting healthy food production and consumation through the educational process

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The paper is based on the research of the possibilities of the promotion of healthy food during the educational process at Master level at the Faculty of Architecture, University of Belgrade, through two theoretical and project-based courses which are focused on sustainable planning and urban design in the natural environment. During 2016-17. i 2017-18. school years these courses were based on recognising and emphasizing of natural advantages of the territory of Maglič, Kraljevo, as well as of the Vlasina lake territory in Serbia, further leading to designing spatial solutions that would contribute to the promotion of a healthy lifestyle and a healthy food. While the wider surrounding of Maglič was recognized as suitable for the development of a special type of tourism - food turism, within the spatial concept of sustainable tourism, cultural and rural development, Vlasina lake area was, in line with its special natural features seen as potential for the spatial development of specific types of agriculture.
The production and consumation of healthy food is drawing a great attention wordlwide, engaging different experts and encouraging multidisciplinary approach to research and creating new solutions. The initial impetus to the production and consumption of healthy food is related to the spatial planning and development of rural areas, hence this premise determined specific methodological framework for education at master level studies.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY
OH19 / FCS19 U/O

Problemi poljoprivrede i sela Republike Srbije

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Republika Srbija poseduje bogate privredne uslove za razvoj poljoprivrede (5.097.000 ha poljoprivrednog zemljišta). Srbija raspolaže i sa kvalifikovanim i obrazovanim ljudskim resursima i odgovarajućim institucijama (srednjim školama, fakultetima, institutima), kao i dugom tradicijom seljačke, odnosno agrarne države. Srbija raspolaže i sa solidnim potencijalima za razvoj prehrambene industrije.
I pored svega toga poljoprivreda i selo u Srbiji su u procesu propadanja, devastacije i zaostajanja. Poljoprivredna proizvodnja u periodu 2000 – 2017 godine, na primer, ostvarila je rast u samo nekoliko godina. Nivo prerade je relativno nizak. Negativni razvojni trend je praćen deagrarizacijom i demografskim pražnjenjem sela. Uzroci toga su mnogobrojni. Potrebna je nova strategija održivog agrarnog razvoja i agrarne politike.

Problems of agriculture and the villages in the Republic of Serbia

Prof. dr Radovan Pejanović
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The Republic of Serbia has rich economic conditions for the development of agriculture (5,097,000 ha of agricultural land). Serbia also has qualified and educated human resources and appropriate institutions (secondary schools, faculties, institutes), as well as a long tradition of peasant or agrarian state. Serbia also has solid potential for the development of the food industry.
Despite all of this, agriculture and the villages in Serbia are in the process of decay, devastation and lagging. Agricultural production in the period of 2000 - 2017, for example, grew in only a few years. The level of processing is relatively low. The negative development trend is accompanied by deagrarization and demographic runoff of the village. There are many reasons to this. A new strategy for sustainable agricultural development and agrarian policy is needed.

OH20 / FCS20 U/O

Улога и значај хране у богослужењу Православне Цркве: литургијски, богословски и еколошки аспекти

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Неоспорна је чињеница да савремени друштвени, културолошки и егзистенцијални изазови са којима се суочава човечанство, иницирају бројна питања међу којима се истичу и она која се односе на начин производње, употребу и вредновање хране у свакодневном животу. Истовремено, ово су инспиративни поводи како за теолошко сагледавање актуелног односа човека према природи, тако и функције и смисла хране у чврстом и течном облику у погледу овоземаљског начина постојања. У овом саопштењу ће бити разматрани литургијски и богословски аспекти улоге и значаја хране у оквиру богослужбеног живота Православне Цркве, као и релевантна еколошка димензија претходно назначене тематике.

Role and significance of food in the worship of the Orthodox Church: Liturgical, theological and ecological aspects

dr Srboljub Ubiparipović
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It is undisputed fact that contemporary social, culturally and existential challenges facing humanity, initiate many questions such as those ones concerning way of production, consuming and evaluation of food in everyday life. In the same time, these are inspiring occasions for theological perception of man's attitude toward nature as well as role and meaning of solid and liquid food for the earthly way of existence. In this communication are going to be studied liturgical and theological aspects of role and significance of food within the scope of liturgical life of the Orthodox Church, and also relevant ecological dimension of already indicated theme.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY
OH21 / FCS21 U/O

ЕТИКА ИСХРАНЕ ОД МАНУА ДО СРЕЈОВИЋА

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Наша идеја је да исхрани треба вратити етичку, а смањити технолошку димензију јер историјски живимо на измаку доба просветитељства одликованом претераном вером у рационализам. Антрополошки проблем је да вештачко и виртуелно добија културни примат над природним и стварним.

Рационалистичка површност исхране је видна у симулакруму култура којима се из практичних разлога не допушта дубље укорењивање, већ се њима управља тако што се ђубриво и вода додају у површински слој чиме се корен охрабрује да не иде даље већ да комфорно задовољи своје потребе на површини. Није потребно дубље укорењивање, већ брзи раст и инфлација што се оправдава профитом.

Када смо 1994. објавили прво издање *Кувара самониклог биља*, који је касније прерастао у *Сунчеву трпезу*, академик Драгослав Срејовић том приликом је рекао - „…култура је увек нешто више од наших биолошких потреба, као што ни исхрана данас не служи само да бисмо преживели…“

Он тиме као да се наставља на древног законодавца Мануа који у *Дхармашастри*, познатој као *Манусмрти*, темељу цивилизације, указује храни велику пажњу.

ETHICS OF NUTRITION FROM MANU TO SREJOVIĆ

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Our idea is that food should have its ethical dimension restored and the technological one reduced. Historically, we live on the brink of the enlightenment era, outlined by the excessive faith in rationalism. The anthropological problem is that by such a stance, the artificial and virtual got a cultural primacy over the natural and real.

Rationalist superficiality appears in the simulacrum of cultures that for practical reasons do not allow deeper rooting, but they are managed by adding fertilizer and water to the surface layer which encourages the root not to go further but to comfortably satisfy its needs on the surface. It does not need deeper rooting, but quick growth and inflation, justified by profit.

When in 1994 we published the first edition of the *Cookbook of Self-sown Plants*, which later grew into *The Sun's Food*, academician Dragoslav Srejović said: “...culture is always more than our biological needs, as nutrition today does not only serve to survive... “ In a way, this thought followed the ancient legislator Manu who in *Dharmashastra*, known as *Manusmrti*, the foundation of civilization, concentrates on nutrition.

UNIFood Conference
Predavanje i usmene prezentacije u okviru sekcija/Lecture and oral presentation within sections
ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OH23 / FCS23 U/O

SIMULATION OF THE FOOD PROCESSING WASTE TREATMENT FOR CLEANER ENVIRONMENT AND BIOENERGY

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It is a well-known fact that meat processing plants usually discharge in the environment (water body, streams and rivers) quite a big quantity of the slaughterhouse wastewater. These meat industries handle usually not only large animals (e.g. pigs, cattle, horses and sheep) but also small livestock (e.g. poultry) which organized in small and medium farms, have been spread all round Albanian territory.
In these conditions, it is of an utmost importance necessity for a special treatment not only for avoiding contamination of the environmental, but also for possible bioenergy profit , due to considerable content of organics and nutrients.

Biological treatment of the wastewaters from slaughterhouses and meat industry has been chosen as a suitable method for samples from slaughter and meat processing in Tirana factory. The process modelling was established accordint to the obtained results and its computer simulation using SuperProDesigner software.

The deriving experimental results, showed that due to rich microorganisms' digestions samples treated with Active Sludge from second decanter, and with Active Sludge, supplied by the municipal wastewater plant, are more effective than those treated with active sludge from oxygenation tank.

The proper model and simulation procedure was established. The flowsheet were included in all respective reports with optimistic results, also those coming from the economic analysis.
From the improved process diagram, it became effective bio methane evolving for the anaerobic digestion involving biodegradation most of the organic maters and nutrients in the raw wastewaters from slaughterhouse.
Keywords: wastewaters from slaughterhouse, biodigestion, process modeling and simulation, process flowsheet, plant design

SIMULACIJA UPRAVLJANJA OTPADOM NAKON OBRADE HRANE U CILJU ČISTIJE OKOLINE I BIOENERGIJE

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Poznata je činjenica da biljke za preradu mesa obično ispuštaju u okolinu (vodno telo, potoke i reke) prilično veliku količinu otpadnih voda iz klanica. Na ovaj način mesna industrija obično obrađuje ne samo velike životinje (npr. svinje, stoku, konje i ovce), već i sitnu stoku (npr. pernatu živinu). Ovaj način obrade, koji se odvija na malim i srednjim poljoprivrednim gazdinstvima, rasprostranjen je na najvećem delu albanske teritorije.

U takvim je uslovima od izuzetne važnosti neophodnost postojanja posebnog tipa obrade, ne samo zbog izbegavanja zagađenja životne sredine, nego i zbog moguće dobiti na polju bioenergije zbog znatnog sadržaja organskih i hranjivih materija.

Biološka obrada otpadnih voda iz klanica i mesne industrije odabrana je kao prikladan metod za uzimanje uzoraka nakon procesa klanja i prerade mesa u fabrici u Tirani. Modeliranje procesa utvrđeno je prema dobijenim rezultatima i kompjuterskoj simulaciji pomoću softvera SuperProDesigner.

Rezultati dobijeni eksperimentalnim metodom pokazali su da su, zbog bogatih digestionih mikroorganizama, uzorci tretirani aktivnim muljem iz drugog dekantera i s aktivnim muljem dobijenim iz komunalnih postrojenja za prečišćavanje otpadnih voda, efikasniji od onih obrađenih aktivnim muljem iz rezervoara za oksidaciju.

Uspostavljen je odgovarajući model i postupak simulacije. Dobijeni dijagrami rada uvršteni su u sve relevantne izveštaje sa optimističnim rezultatima, a takođe u one koji su dobijeni finansijskom analizom.

Iz poboljšanog procesnog dijagrama uočava se efikasnost bio-metana koji se razvija za anaerobnu digestiju koja uključuje biorazgradnju većine organskih i hranjivih materija u sirovim otpadnim vodama iz klanice.
Ključne reči: otpadne vode iz klanica, biodigestija, postupak modeliranja i simulacije, postupak izrade dijagrama, plan fabrike

UNIFood Conference
Posterska prezentacija u okviru sekcija / Poster presentation within sections
HRANA I ZDRAVLJE / FOOD AND HEALTH

HZP1 / FHP1

Etarsko ulje i postdestilacioni ostatak *Juniperus communis*: antibakterijski efekat prema kontaminentima hrane i *in vitro* citotoksični potencijal na humanim ćelijama kolona

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Prisustvo mikroogranizama u namirnicama može dovesti do kvarenja istih, ili imati ozbiljnije posledice u vidu intoksikacije ili razvoja infekcija. Usled potencijalnog štetnog efekta primene veštačkih aditiva, istraživanje prirodnih proizvoda sve više dobija na značaju. Cilj rada bio je ispitati antibakterijski efekat etarskog ulja (EO) i postdestilacionog ostatka (PDW) *Juniperus communis*. Kako bi se procenila selektivnost prema bakterijama, testirana je i citotoksičnost prema humanim ćelijama kolona (HT-29 i HCT116) i izračunate su vrednosti indeksa selektivnosti (SI).
GC-MS analiza je pokazala da je dominantna komponenta EO α-pinen (23.61%), dok je LC-MS/MS metodom utvrđeno da su rutin (12.2 mg g^{-1}) i hinska kiselina (11.1 mg g^{-1}) najzastupljeniji među identifikovanim konstituentima PDW. Rezultati MIC testa su pokazali da je efekat PDW bio jači, pri čemu je *Listeria monocytogenes* bila najosetljivija među testiranim sojevima (MIC i MBC vrednosti su iznosile 0.39 mg mL^{-1} i 0.78 mg mL^{-1}). U daljem istraživanju, metodom šahovske table (Checkerboard test) ispitan je kombinovani efekat EO/PDW sa antibioticima (streptomicin, ampicilin, hemomicin) prema *L. monocytogenes*. Dobijeni rezultati ukazali su na postojanje svih tipova interakcija, pri čemu je sinergizam bio dominantan. Izuzetak je kombinacija EO i hemomicina, gde je pretežno dobijen indiferentan efekat. MTT testom je utvrđeno da je najveći citotoksični potencijal ostvaren primenom EO prema HT-29 ćelijskoj liniji (IC_{50}=86.9 µg mL^{-1}), dok je citotoksičnost PDW bila značajno manja.
Analiza selektivnosti ukazala je da su pozitivne SI vrednosti u odnosu na obe ćelijske linije dobijene prema *L. monocytogenes* i to nakon tretmana PDW-om. U daljem istraživanju ispitan je efekat PDW na adhezivnu sposobnost *L. monocytogenes*, pri čemu je pokazana snažna inhibicija adhezije na HT-29 i HCT116 ćelijama (28% i 62%). Dobijeni rezultati ohrabruju i stimulišu dalja ispitivanja antibakterijskog efekta PDW *J. communis*.

Juniperus communis essential oil and post-destilation waste: antibacterial effect against food contaminants and *in vitro* cytotoxicity against human colon cells

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Microorganisms in foods can lead to spoilage and have serious consequences in terms of intoxication, as well as infection development. Due to potential harmful effect of synthetic additives, the investigation of natural products is encouraged. The aim of this study was to investigate the antibacterial effect of essential oil (EO) and post-destillation waste (PDW) of *Juniperus communis*. In order to estimate the selectivity against bacteria, cytotoxicity on human colon cells (HT-29 and HCT116) was determined, and the selectivity index (SI) values were calculated.
GC-MS analysis identified α-pinen (23.61%) as the dominant component of EO, while LC-MS/MS method showed that rutin (12.2 mg g^{-1}) and quinic acid (11.1 mg g^{-1}) were the most abundant among identified constituents of PDW. Results obtained in MIC assay showed that PDW was more efficient and that *Listeria monocytogenes* was the most sensitive among tested strains (MIC and MBC were 0.39 and 0.78 mg mL^{-1}, respectively). Furthermore, using the checkerboard method, the combined effect of EO/PDW with chosen antibiotics (streptomycin, ampicillin, hemomycin) was examined against the *L. monocytogenes*. Results obtained showed all types of interactions, predominantly synergism, with the exception of EO and hemomycin combination, where the indifferent effect was dominant. MTT assay indicated that the highest cytotoxic potential was obtained in the case of EO and against HT-29 cells (IC_{50} value 86.9 µg mL^{-1}), while the effect of PDW was notably lower.
Selectivity analysis showed that the positive SI values regarding both colon cell lines were obtained only when PDW was tested against *L. monocytogenes*. According to this, in further study we monitored PDW effect on *L. monocytogenes* adhesion properties. Results showed strong inhibition of adhesion on HT-29 and HCT116 cells (28% and 62%, respectively). Obtained results are encouraging and stimulate further research of antibacterial potential of *J. communis* PDW.

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Posterska prezentacija u okviru sekcija / Poster presentation within sections
HRANA I ZDRAVLJE / FOOD AND HEALTH

HZP2 / FHP2

Potencijalni mehanizmi zaštitnog dejstva ekstrakta lista masline kod ugljen tetrahloridom indukovanog akutnog oštećenja jetre pacova

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Ugljen tetrahloridom (CCl_4)-indukovano oštećenje jetre je eksperimentalni model koristan za ispitivanje zaštitnog i terapijskog dejstva farmakološki aktivnih supstanci kod oboljenja jetre. Taj model smo koristili da ispitamo hepatoprotektivno dejstvo prirodnog antioksidansa, suvog ekstrakta lista masline (DOLE) kod mužjaka Wistar pacova. Životinje su podeljene u četiri grupe: Kontrolna grupa je 3 dana intragastrično (*i.g.*) dobijala fiziološki rastvor; DOLE grupa je 3 dana primala samo DOLE (80 mg/kg, *i.g.)*; CCl_4 grupi je 3 dana davan po 1 ml fiziološkog rastvora *i.g*, a potom intraperitonealna (*i.p.*) injekcija CCl_4 (1 ml/kg); DOLE+CCl_4 grupa dobijala je DOLE, 80 mg/kg *i.g.*, 3 dana i 1 ml/kg CCl_4 *i.p.*, 30 minuta nakon poslednje doze DOLE. Intraperitonealno aplikovan CCl_4 indukovao je masivnu nekrozu jetre, povećao vrednosti transaminaza u serumu (ALT, AST) i doveo do perturbacija parametara oksidativnog stresa u tkivu jetre (koncentracija MDA i glutationa, aktivnost katalaze). Oralna primena DOLE dovela je do značajno nižih aktivnosti enzima jetre, kao i do manjeg oštećenja parenhima jetre što je potvrđeno histopatološkom analizom. DOLE je modulisao aktivnost katalaze i nivo glutationa, ukazujući na to da je antioksidativni mehanizam odgovoran za njegovo hepatoprotektivno dejstvo. Western blot analiza potvrdila je povećanje ekspresije LC3-II i smanjenje p62, u tkivu jetre sa CCl_4 indukovanim oštećenjem. Ekspresija kaspaze 3 i citohroma c kao markera apoptoze, nije bila promenjena, međutim, energetski balans hepatocita je bio promenjen jer je aktivnost AMP-aktivisane proteinske kinaze (AMPK) bila povećana u toku CCl_4 tretmana. DOLE pretretman nije uticao na proteine koji su u vezi sa autofagijom, ali aktivnost AMPK je bila značajno smanjena, ukazujući na perturbaciju energetskog balansa kao dodatni mehanizam hepatoprotektivnog dejstva ekstrakta lista masline.

Potential mechanisms of the protective activity of olive leaf extract in carbon tetrachloride - induced acute liver injury in rats

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Carbon tetrachloride (CCl_4)-induced liver damage is experimental model useful for examination of protective and therapeutic effect of pharmacologically active substances in liver diseases. In this study, we used this model to investigate hepatoprotective activity of natural antioxidant, dry olive leaf extract (DOLE) in male Wistar rats. The animals were divided into four groups: Control group received saline intragastrically (*i.g.*), for 3 consecutive days; DOLE group received only DOLE diluted in saline (80 mg/kg, *i.g.)*, for 3 days; the CCl_4 group received 1 ml of saline *i.g*, for 3 days followed by intraperitoneal (*i.p.*) injection with CCl_4 (1 ml/kg); DOLE+CCl_4 group received DOLE, 80 mg/kg *i.g.*, for 3 days and 1 ml/kg of CCl_4 *i.p.*, 30 minutes after the last dose of DOLE. Intraperitoneally administered CCl_4 induced massive hepatic necrosis, increased serum transaminases (ALT, AST) and induced perturbation of oxidative stress parameters in liver tissue (MDA and glutathione concentration and catalase activity). Oral administration of DOLE led to significantly lower liver enzyme activities, as well as less damage of the liver parenchyma, which is confirmed by histopathological findings. Furthermore, DOLE modulated catalase activity and glutathione content suggesting that antioxidative mechanism is responsible for its hepatoprotection. Western blot analysis confirmed the upregulation of microtubule-associated protein 1 light chain 3 (LC3-II) and downregulation of p62, in the livers with CCl_4 induced damage. The expression of caspase-3 and citochrome c as markers of apoptosis, were not affected. However, the energy balance of hepatocytes was affected since AMP-activated protein kinase (AMPK) activity was increased during CCl_4 treatment. Pretreatment with DOLE did not influence the expression of autophagy-associated proteins but AMPK activity was significantly decreased suggesting the energy balance perturbation as an additional mechanism of DOLE hepatoprotective effect.

HZP3 / FHP3

UNIFood Conference
Posterska prezentacija u okviru sekcija / Poster presentation within sections
HRANA I ZDRAVLJE / FOOD AND HEALTH

Kontaminacija dodataka ishrani

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Toksični elementi (Hg, As, Pb i Cd) mogu teško oštetiti hematopoetski, imuni, nervni i reproduktivni sistem. Ovi elementi imaju svojstvo da se akumuliraju, jer ne mogu u potpunosti da se ekskretuju iz organizma. Živa se u prirodi može naći kao elementarna, neorganska i organska živa. Koristi se kao antiseptičko sredstvo, konzervans, u pesticidima, pigmentima itd.
Cilj istraživanja je da se ispita prisustvo žive u dodacima ishrani koji se nalaze na tržištu Republike Srpske. Kao posljedica prisustva žive može doći do alergijskih reakcija, ali i do sistemske apsorpcije žive i njene akumulacije u organizmu, što može dovesti do ispoljavanja toksičnih efekata i ugrožavanja ljudskog zdravlja. Ukupne koncentracije žive u uzorcima određene su metodom amalgamacije atomske apsorpcione spektrofotometrije pomoću direktnog analizatora žive (DMA-80). Radni princip instrumenta zasnovan je na termičkoj degradaciji, katalitičkoj konverziji, amalgamaciji i atomskoj apsorpcionoj spektrofotometriji. Apsorpcioni intenzitet je mjeren na 253.7 nm. Proizvodi razlaganja se prenose neprekidnim protokom čistog kiseonika kroz katalizator gdje se uklanjaju ometajući faktori. Kalibraciona kriva konstruisana je u opsegu od 0.5-10.0 ng/kg. Postignut je koeficijent korelacije r = 0.9998. Koncentracija Hg u odabranim uzorcima dodataka ishrani nije prešla maksimalno dozvoljenu koncentraciju (MDK = 0.1 mg/kg) koja je definisana zakonskom regulativom za kontaminante u dodacima ishrani. Sadržaj žive u svim ispitivanim uzorcima je bio u skladu sa zakonskom regulativom koja je na snazi u Republici Srpskoj.

Contamination of dietary supplements

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Mercury, cadmium and lead are considered as major polluters of the environment from the group of metals that can have harmful effects on human health. These elements have the capacity to accumulate, because they can not completely excrete from the body. Mercury (Hg) can be found as elemental, inorganic and organic mercury. It is often used as an antiseptic agent, a preservative, in pesticides, pigments, etc.
The aim of the study is to investigate the presence of mercury in food supplements present on the Republic of Srpska market. Mercury can cause serious allergic reactions, but also the systemic absorption of the mercury and its accumulation in the organism can lead to very toxic effects and endangering of human health. Total Hg concentrations in tested samples were determined by the method of amalgamation of atomic absorption spectrometry using direct mercury analyzer (DMA-80). The working principle of the instrument is based on the thermal decomposition, catalytic conversion, amalgamation and atomic absorption spectrophotometry. The absorption iintensity was measured at 253.7 nm. Products of decomposition are carried by continuous flow of pure oxygen through a catalyst bed, where interferences are eliminated. The linear calibration curve in the range of 0.5–10.0 ng /kg was plotted. The correlation coefficient r = 0.9998 was achieved. Concentration of Hg in tested food supplement did not exceed the maximum permitted concentrations (MPCs =0.1 mg/kg) set by the commission regulation for contaminants in food supplements. The mercury content of all tested samples was in accordance with the legislation in the Republic of Srpska.

Socijalni aspekt celijakije, naša iskustva

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Pacijenti sa celijačnom bolešću moraju biti pažljivi prilikom konzumacije hrane koja nije pripremljena u domaćinstvu s obzirom na mogućnost prisustva glutena. Nedostupnost hrane bez glutena izvan domaćinstva i niska svijest o bolesti je predstavljala problem proteklih godina, iako se to sada brzo mijenja. Grupe za podršku pacijentima su igrale važnu ulogu poslednjh decenija, organizujući specijalne događaje za pacijente i njihove porodice, organizujući edukaciju pacijenata, doktora i industrije usluge hrane.
Studijeprovedene u svijetu pokazuju da su se pacijenti plašili društvenih sadržaja, kao što su restorani ili okupljanja, jer su to prilike u kojima ih je moguće identifikovati kao oboljelu osobu. Postoje kontradiktorni rezultati o vezi između saglasnosti sa dijetom i kvalitetom života. Posmatrajući adolescente, Wagner i saradnici su u istraživanju otkrili da loša saglasnost sa GlutenFreeDiet jeste glavni uzrok generalno niskog kvaliteta života. Adolescenti koji nisu u saglasnosti sa dijetom su imali više fizičkih problema, veći teret zbog bolesti, više su se osjećali bolesnima i imali su više porodičnih problema. Osim toga, kod ovih pacijenata, zakašnjela dijagnoza je bila povezana sa većim problemima u školi i društvenim aktivnostima.
U našem istraživanju, od učesnika je traženo da izaberu sa liste dvije stvari koje bi mogle poboljšati kvalitet života njima i njihovim porodicama. Anketirano je 30 pacijenata. 12 je bilo osoba ženskog pola a 18 je bilo muškaraca. Ispitanici su imali između 11 i 36 godina. Oni su najčešće birali odgovore: 'posebni odjeli proizvoda bez glutena u prodavnicama' koji je izabralo 66.66% učesnika, potom 'meni bez glutena u restoranima', što je izabralo 56.66% i 'informativne kampanje u svim društvenim kontekstima' (npr škole, restorani, zdravstvene ustanove) njih 53.33%. 40% pacijenata je izabralo 'bolje označavanje'; 36.66% je izabralo 'raniju dijagnozu', a 30% njih je izabralo 'bolje dijetalno savjetovanje'.
Literaturna pretraga i naše istaživanje ukazuje da su celijačni pacijenti još uvijek ranjivi prilikom adaptacije u društvenom životu. Planiranje intervencija, kojima bi se poboljšala adaptacija pacijenata tom stanju i njegovim ograničenjima, i posljedično njihovim kvalitetu života su neophodni.

Social aspect of celiac disease, our experience

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Patients with celiac disease must be careful when consuming food that is not prepared in the household, considering the possibility of presence of gluten. The unavailability of non-household gluten-free food and low awareness of the disease was a problem in recent years, although this is now changing rapidly. Patient-support groups have played an important role in the last decades, organizing special events for patients and their families, as well as education for patients, doctors and the food industry.
Studies conducted around the world show that patients are scared of social content, such as eating in restaurants or gatherings, because they can be identified as a diseased person. There are contradictory results on the relationship between diet and quality of life. Looking at adolescents, Wagner and colleagues found that poor compliance with GlutenFreeDiet is a major cause of the generally low quality of life. Adolescents who did not agree with the diet had more physical problems, a greater burden of illness, more feelings as they are sick, and more family problems. In addition, in these patients, the late diagnosis was associated with major problems in school and social activities.
In our research, participants were asked to select from the list two things that could improve the quality of life for them and their families. 30 patients were interviewed. 12 were female and 18 were men. The subjects were between 11 and 36 years old. They mostly chose the answers: 'Special Departments of Gluten-free Products in Stores' 66.66% of participants, then 'gluten-free menu in restaurants' 56.66% and 'information campaigns in all social contexts' (eg schools, restaurants , health institutions) 53.33% of patients. Furthermore, 40% of patients chose 'better labeling'; 36.66% chose 'previous diagnosis', and 30% chose 'better dietary counseling'.
Literary inquiry and our research indicate that celiac patients are still vulnerable to adaptation in social life. Planning interventions, which would improve the adaptation of patients to that condition and its limitations, and consequently their quality of life, are necessary.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZP5 / FCSP5

Protektivni efekat kokosovog ulja na aloksan-indukovani dijabetes kod pacova

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Dijabetes melitus (DM) je metabolički, endokrini poremećaj nastao usled nedostatka sekrecije i delovanja insulina. Uprkos prisustvu velikog broja lekova za lečenje dijabetesa, komplikacije izazvana ovom bolešću ostaje glavni zdravstveni problem. Pored toga, dugotrajna oralna upotreba antidijabetičkih lekova vremenom dovodi do značajnog smanjenja njihove efikasnosti. Zbog toga je veoma značajno traganje za medikamentima biljnog porekla koji bi omogućili dugotrajnu kontrolu glukoze u krvi kod pacijenata sa dijabetesom tipa 2. Stoga je glavni cilj ove studije bio da se utvrditi blagotvorno dejstvo *Cocos nucifera* ulja (VCO) na aloksan-indukovani dijabetes kod pacova.
Aloksan se najčešćih koristi za indukciju dijabetesa zato što izaziva uništavanje B ćelija pankreasa. Eksperimentalni model obuhvatao je četiri grupe pacova, koje su se međusobno razlikovale kombinacijama aloksan (Alk) tretmana i davanja kokosovog ulja. Glikemijski nivo, povećanje telesne mase (mereno nedeljno), unos hrane i vode (mereno dnevno), mereno je tokom čitavog eksperimenta (16 nedelja).
Dodavanje kokosovog ulja dovodi do značajnog povećanja telesne mase ali smanjuje glikemiju i unos hrane i vode u VCO grupi u poređenju sa kontrolom. Tretman Aloksanom očigledno povećava prosečnu glikemiju u grupama Alk i Alk + VCO u poređenju sa kontrolnim grupama. Međutim, hipoglikemijski efekat kokosovog ulja uočen kod VCO životinja nije primećen kod dijabetičara tj. nema značajne razlike u glikemiji između Alk i Alk + VCO grupa. Ovakav rezultat je verovatno zbog činjenice da je glikemija već veoma visoka kod dijabetesa i da se zbog toga ne može uočiti hipoglikemični efekat kokosovog ulja.
Blagotvoran efekat devičnog kokosovog ulja na neke fiziološke parametre povezane sa dijabetesom kod pacova, kao što je unos hrane i vode, i prosečni porast telesne težine su jasno pokazani u ovom radu.

Beneficial effect of virgin coconut oil on alloxan-induced diabetes in rats

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Diabetes mellitus (DM) is a metabolic, the endocrine disorder resulting from a deficiency in insulin secretion and insulin action. Despite the presence of a large number of medicines for the treatment of diabetes, the complication caused by this disease remains a major medical problem. In addition, long-term oral use of antidiabetic drugs leads to their inefficiency. Therefore, search for oral herbal medicinal products for long-term blood glucose control in patients with type 2 diabetes is very important. Therefore, the main goal of this study was to determine the beneficial effect of *Cocos nucifera* oil (VCO) on alloxan-induced diabetes in rats.
Alloxan is one of the most important and the most frequent chemical approaches causing B pancreatic cells destruction. The experimental model involved the four groups of rats, differing from each other by the combinations of alloxan (Alx) treatment and coconut oil administration. The glycemic level, body mass gain (measured weekly), food and water intake (measured daily), were measured during the whole experiment (16 weeks).
Coconut oil supplementation significantly increases body mass gain, and lowers glycaemia and food and water intake in the VCO group by comparison to controls. Alloxan treatment conspicuously increases the average fasting glycaemia in the Alx and Alx+VCO groups as compared to control groups. However, the hypoglycemic effect of coconut oil seen in the VCO animals was not observed in the diabetic animals: there is no significant difference in glycaemia between Alx and Alx+VCO groups. It could be due to the fact that glycaemia is already very high in diabetes and cannot be further influenced by the mild hypoglycemic effect of coconut oil.
The beneficial effect of virgin coconut oil on some physiological parameters associated with diabetes in rats, such as intake of food and water, and an average gain in body weight has clearly been shown in this paper.

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HZP6 /FHP6

Antivirusna aktivnost odabranih ekstrakata makrogljive *Trametes versicolor* (L.) LIoyd 1921

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Cilj ovog rada bio je da se odredi antiviralna aktivnost odabranih ekstrakata makrogljive *Trametes versicolor* (L.) LIoyd 1921 u *in vitro* uslovima na fagu vB_BbrS_LK3 (Siphoviridae) čiji je domaćin bakterija *Bordatella bronchiseptica* ATCC 10580. Testirani su vodeni, etanolni i metanolni ekstrakti u rasponu koncentracija od 1 do 10 mg/mL. Pri najvećoj testiranoj koncentraciji (10 mg/mL) metanolni ekstrakt makrogljive *T. versicolor* ispoljio je značajan procenat inhibicije faga (98,31±0,60 %). Dalje istraživanje sezonskog tipa ima za cilj da pokrije više lokaliteta, radi eventualnog pronalska potentnijeg uzorka date vrste gljive za potrebe organske hemijske analize.

Antiviral activity of the selected extracts of the macrofungal species *Trametes versicolor* (L.) LIoyd 1921

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The aim of this work was to investigate antimicrobial activity of the selected extracts of the macrofungal species *Trametes versicolor* (L.) LIoyd 1921 at *in vitro* conditions using the phage vB_BbrS_LK3 (Siphoviridae) with the bacterium *Bordatella bronchiseptica* ATCC 10580 as a host. Its water, ethanol and methanol extracts (1-10 mg/mL) were tested. At the highest tested concentration (10 mg/mL) methanol extract of the macrofungus *T. versicolor* displayed a profound percentage of the phage inhibition (98.31±0.60 %). Further seasonal type study aims to cover more localities, due to the eventual discovery of more potent sample of the given fungal species for the need of organic chemical analysis.

HZP7 / FHP7

Osvrt na antimikrobnu aktivnost ekstrakata odabranih autohtonih makrogljiva

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Cilj ovog rada bio je da se odredi antimikrobna aktivnost ekstrakata sedam odabranih autohtonih makrogljiva (pet lignikolnih i dve terikolne vrste) u *in vitro* uslovima. Ipsitivana je antibakterijska i antifungalna aktivnost. Dok je antibakterijska aktivnost skrinovana na pet Gram-pozitivnih i osam Gram-negativnih bakterija, antifungalna aktivnost testirana je na tri soja *Candida albicans*, kao i na pet izolata fitopatogenih plesni. Sveukupno, vrsta *Hydnum repandum* L. 1753, jestiva dok je mlada, izdvojila se po svom antimikrobnom potencijalu. Kao takva, biće predmet daljih istraživanja, pre svih drugih, u oblasti hemije prirodnih proizvoda, farmaceutske biologije i biotehnologije.

An insight into antimicrobial activity of the extracts of selected autochtonous macrofungi

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The aim of this work was to determinate antimicrobial activity of the extracts of seven selected autochtonous macrofungi (five lignicolous and two terricolous species) at *in vitro* conditions. It included testing of both, antibacterial and antifungal activities. While antibacterial activity was screened towards five Gram-positive and eight Gram-negative bacteria, antifungal activity was tested on three strains of *Candida albicans* followed by five isolates of phytopathogenic molds. In summary, the macrofungal species *Hydnum repandum* L. 1753, edible when young, stood out due to its antimicrobial potential. As such, it will be the subject of further studies, first of all, in the field of chemistry of natural products, pharmaceutical biology and biotechnology.

Osvrt na elementalni sastav odabranih makrogljiva

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Cilj ovog rada bio je da se odredi sadržaj mikroelemanata u odabranim uzorcima makrogljiva, radi preliminarne procene njihovog bioindikatorskog potencijala i bezbedne konzumacije. Sadržaj mikroelemenata (Cd, Pb, Cr, Ni, Cu, Mn, Fe i Zn) utvrđen je u 10 sakupljenih uzoraka makrogljiva tokom 2017. godine sa 5 šumskih i 1 gradskog lokaliteta, popularnim među lokalnim stanovništvom. Analizirani bazidiokarpi obuhvatili su 7 familija, kako jestive (4) i nejestive (5), tako i 1 otrovnu vrstu. Zbog visoke akumulacije pomenutih mikroelemenata, trebalo bi izbegavati sakupljanje jestive vrste *Agrocybe cylindracea* i nejestive vrste *Stereum hirsutum* na relevantnim lokalitetima (Vorovo /Fruška Gora/ i Liman /Novi Sad/). Nasuprot tome, upotreba preostale tri vrste (*Ganoderma lucidum*, *Laetiporus sulphureus* i *Meripilus giganteus*) mogla bi se preporučiti u ishrani, pod uslovom da studije sezonskog tipa u višegodišnjem intervalu potvrde uočeni trend.

An insight into elemental composition of selected macrofungal species

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The aim of this study was to determine the content of microelements in the selected macrofungal species, for the preliminary assessment of their bioindicator potential and safe consumption. The content of microelements (Cd, Pb, Cr, Ni, Cu, Mn, Fe and Zn) was determined in 10 samples of macrofungi collected during 2017 from 5 forest and 1 urban locations, popular among the local people. The analysed basidiocarps included 7 families, edible (4), inedible (5) and poisonous (1) species. For the reason of high accumulation of the aforementioned microelements, the collecting of edible *Agrocybe cylindracea* and inedible *Stereum hirsutum* at the relevant sites (Vorovo /Fruska Gora/ and Liman /Novi Sad/) should be avoided. On the contrary, the use of three remaining species in nutrition (*Ganoderma lucidum, Laetiporus sulphureus* and *Meripilus giganteus*) could be recommended, if the observed trend would be confirmed by the seasonal-type studies lasting for more years.

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HZP9 / FHP9

Dekokt biljke *Nepeta nuda* kao potencijalni izvor antimikrobnih agenasa

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Nepeta nuda L. (sin. *Nepeta panonica* L.) pripada familiji Lamiaceae, i predstavlja jestivu biljku sa raznovrsnim lekovitim svojstvima uključujući diuretično, antiseptično i druga dejstva. Prilikom destilacije etarskog ulja *N. nuda* dobijen je sporedni proizvod, dekokt, čiji je hemijski sastav određen pomoću Orbitrap LC-MS analize. Mikrodilucionom metodom je ispitana antimikrobna aktivnost dekokta na 8 sojeva bakterija i upoređena sa aktivnošću komercijalnih antibiotika.
Hemijska analiza je potvrdila prisustvo sledećih jedinjenja: kafeinske kiseline, 7-deoksiloganinske kiseline, iksorozida, 3,4-dihidroksifenil-2-hidroksi-3-oksopent-4-enoata, ruzmarinske kiseline i kvercetina. Dekokt je pokazao umerenu antimikrobnu aktivnost, sa minimalnim inhibitornim koncentracijama (MIK) u rasponu 10-40 mg/mL. Najotpornije na tretman dekoktom bile su bakterije *Escherichia coli* i *Pseudomonas aeruginosa* (MIK 40 mg/mL). Komercijalni antibiotici, streptomicin i ampicilin, su pokazali intenzivniji antimikrobni potencijal. Dekokt *N. nuda* je pokazao umerenu antimikrobnu aktivnost, te se njegovo korišćenje u te svrhe može dalje ispitivati, naročito ukoliko se uzme u obzir sve češća pojava rezistencije bakterija na komercijalne antibiotike, kao i različite nuspojave koje se javljaju kao posledica njihovog korišćenja.
S obzirom da jedinjenja prisutna u dekoktu ispoljavaju širok dijapazon bioloških funkcija, postoji još mogućih namena za koje bi se ovaj proizvod, do sada smatran otpadnim proizvodom, mogao ispitati.

Decoct of *Nepeta nuda* as potential source of antimicrobial agents

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Nepeta nuda L. (syn. *Nepeta panonica* L.) belongs to the family Lamiaceae; it is edible plant with various medicinal properties including diuretic, antiseptic and others. During the distillation of *N. nuda* essential oil a by-product was obtained, decoct. Chemical composition of *N. nuda* decoct was also determined by using Orbitrap LC-MS. Its antimicrobial activity was tested on 8 strains of bacteria by microdilution method and it has been compared with the activity of commercial antibiotics.
The chemical analysis confirmed the presence of the following compounds: caffeic acid, 7-deoxyloic acid, ixoroside, 3,4-dihydroxyphenyl-2-hydroxy-3-oxopent-4-enoate, rosmarinic acid and quercetin. Decoct has shown moderate antimicrobial activity, with minimal inhibitory concentrations (MIC) in range 10-40mg/mL. The most resistant bacteria to the treatment were *Escherichia coli* and *Pseudomonas aeruginosa* (MIC 40 mg/mL). Commercial antibiotics, streptomycin and ampicillin, showed a better antimicrobial potential. *N. nuda* decoct showed promising antimicrobial activity and its use for this purpose could be further investigated, especially since there is increasing trend in antibiotic resistance among bacteria, together with numerous side effects that are consequence of antibiotics intake.
Since the compounds found in the decoct exhibit a wide range of biological functions, there are other possible applications for this porduct, which was previously considered as a waste by-product.

HZP10 / FHP10

Uticaj dijetarnih fenolnih kiselina na markere agonistom indukovane aktivacije trombocita

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Sve više dokaza ukazuje na zaštitnu ulogu polifenola, fitohemikalija zastupljenih u voću povrću i žitaricama, u nastanku kardiovaskularnih bolesti. Ovi pozitivni efekti se delom mogu pripisati direktnom dejstvu polifenola na aktivaciju trombocita, kao procesa sa važnom ulogom u patogenezi kardiovaskularnih bolesti. Cilj ovog rada bio je da se ispita uticaj nekoliko fenolnih kiselina, grupe polifenolnih jedinjenja sa najvećim doprinosom ukupnom dijetarnom unosu polifenola, na parametre aktivacije trombocita.
Uzorci pune krvi zdravih ispitanika (n=7) tretirani su vanilinskom, protokatehuinskom, hipurnom i ferulinskom kiselinom, pri koncentracijama od 0.2 do 20μM. Parametri aktivacije trombocita, ekspresija P-selektina i GPIIbIIIa, određivani su protočnom citometrijom nakon *ex vivo* delovanja agonista adenozin-difosfata.
Protokatehuinska kiselina je pri 0.2μM koncentraciji smanjila procenat P-selektin- i GPIIbIIIa-pozitivnih trombocita, kao i gustinu receptora GPIIbIIIa na aktiviranim trombocitima za 5.9 %, 3.3 % i 5.9 %, redom. Slično tome, pri koncentraciji od 2μM, ova kiselina je smanjila gustinu P-selektina, procenat GPIIbIIIa-pozitivnih trombocita i gustinu GPIIbIIIa za 5.2%, 5.4% i 5.7%, redom. Hipurna kiselina, pri koncentraciji od 2μM, je značajno smanjila procenat P-selektin-pozitivnih ćelija za 4.3%, dok je pri koncentraciji od 20μM smanjila procenat P-selektin i GPIIbIIIa-pozitivnih trombocita i gustinu GPIIbIIIa receptora za 5.9%, 4.9% i 6.9%, redom. Ferulinska i vanilinska kiselina nisu značajno uticale na ispitivane markere aktivacije trombocita pri bilo kojoj testiranoj koncentraciji.
Ovi rezultati pokazuju kapacitet protokatehuinske i hipurne kiseline da pri fiziološki relevantnim koncentracija vrše modulaciju aktivacije trombocita, doprinoseći blagotvornom dejstvu konzumacije namirnica bogatih polifenolima na kardiovaskularno zdravlje.

Impact of dietary phenolic acids on agonist-induced markers of platelet activation

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Growing evidence suggests the protective role of polyphenols, phytochemicals present in fruits, vegetables and grains, against the development of cardiovascular diseases. These benefits may partly be ascribed to a direct effect of polyphenols on platelet activation, the important process in the pathogenesis of cardiovascular diseases. The aim of this study was to investigate the impact of several phenolic acids, the most abundant polyphenol compounds in the human diet, on markers of platelet activation.
The whole blood samples from healthy volunteers (n=7) were incubated with vanillic, protocatechuic, hippuric and ferulic acids at 0.2 to 20μM concentrations. The parameters of platelet activation, P-selectin and GPIIbIIIa expressions, were determined by flow cytometry after the *ex vivo* activation with the agonist adenosine diphosphate.
Protocatechuic acid at 0.2μM levels decreased the percentage of P-selectin- and GPIIbIIIa-positive platelets and the density of GPIIbIIIa on activated platelets by 5.9 %, 3.3 % and 5.9 %, respectively. Similarly, at 2μM concentration, this acid reduced P-selectin density, the percentage of GPIIbIIIa-positive platelets and GPIIbIIIa density by 5.2 %, 5.4 %, and 5.7 %, respectively. Hippuric acid, at 2μM concentration significantly decreased the percentage of P-selectin positive cells by 4.3 %, while at 2μM it reduced the precentage of P-selectin- and GPIIbIIIa-positive platelets as well as the GPIIbIIIa receptor density by 5.9%, 4.9% and 6.9%, respectively. Both ferulic and vanillic acids did not significantly attenuate the investigated markers of platelet activation at any tested concentration.
These results showed the capacity of protocatechuic and hippuric acid to modulate platelet activation at physiologicaly relevant concentartions, possibly contributing to the beneficial effects of the consumption of polyphenol-rich foods on cardiovascular health.

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HZP11 / FHP11

Vodeni ekstrakt gljive *Coprinellus disseminatus* (Pers.: Fr.) S.F. Gray efikasno inhibira enzim acetilholinesterazu

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Cilj ove studije bio je da se u uslovima *in vitro* ispita anti-acetilholinesterazna aktivnost odabranih ekstrakata gljive *Coprinellus disseminatus* (Pers.: Fr.) S.F. Gray sakupljene na Fruškoj Gori. Data bioaktivnost određena je pomoću Elmanove metode, a rezultati su prikazani kao vrednosti IC_{50} i IC_{90}. Kao najpoteniji, izdvojio se vodeni ekstrakt (IC_{90} = 1,44 mg/mL) koji će, stoga, biti predmet daljeg istraživanja (izolovanje bioaktivnih principa i njihova identifikacija). Pri povoljnim okolnostima, upotreba ove vrste gljive u redovnoj ishrani kod obolelih od Alchajmera mogla bi, u najmanju ruku, da unapredi aktuelnu palijativnu terapiju.

The aqueous extract of the fungus *Coprinellus disseminatus* (Pers.: Fr.) S.F. Gray effectively inhibits the enzyme acetylcholinesterase

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This study aimed to determinate at *in vitro* conditions anti-acetylcholinesterase activity of the selected extracts of the fungus *Coprinellus disseminatus* (Pers.: Fr.) S.F. Gray collected on Fruska Gora mountain. The aforementioned bioactivity was estimated using Ellman's method, while the results are expressed both as IC_{50} and IC_{90} values. As the most potent one, the aqueous extract (IC_{90} = 1.44 mg/mL) stood out; therefore, it will be the subject of further research work (isolation of bioactive principles and their identification). Under beneficial circumstances, the use of this fungal species in a regular diet of Alzheimer's patients might at least improve the current palliative therapy.

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HZP12 / FHP12

Antioksidativna i antimikrobna aktivnost ekstrakata *Rosa canina* L. sa Vlasinske visoravni

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Cilj ovog rada bio je ispitivanje antioksidativne i antimikrobne aktivnosti ekstrakata vrste *Rosa canina* L. sa Vlasinske visoravni. Plodovi ruže se koriste prvenstveno u ishrani (čaj, džem, sok). Značajna je njihova primena u lečenju prehlade, suvog kašlja i dijareje. Sveži plodovi ruže su usitnjeni i ekstrahovani pomoću polarnih rastvarača, metanola i etanola korišćenjem metode ultrazvučne ekstrakcije. U ekstraktima je potvrđeno prisustvo fenola spektrofotometrijski, korišćenjem Folin-Ciocalteau reagensa, pri čemu je veća količina ovih jedinjenja konstatovana u etanolnom ekstraktu (6,18 mg GA/g suvog ekstrakta). Sadržaj flavonoida dobijen reakcijum sa aluminijum nitratom nonahidratom, pokazao je približno iste vrednosti flavonoida u oba ekstrakta. Metanolni ekstrakt je bio efikasniji antioksidativni agens korišćenjem 2,2-difenil-1-pikrilhidrazila (DPPH) metode (0,54 mg/ml) u odnosu na etanolni ekstrakt (0,64 mg/ml). U ABTS (2,2'-azino-bis(3-etilbenzotiazolin-6-sulfonska kiselina) testu pokazano je da etanolni ekstrakt poseduje jači slobodno radikalski potencijal (0,20 mg VitC/g suvog ekstrakta). Za testiranje antimikrobne aktivnosti na patogene izolovane iz hrane korišćena je metoda mikrodilucije. Određivane su minimalne inhibitorne koncentracije (MIK). Najosetljivija bakterija na testirane ekstrakte je bila vrsta *Pseudomonas aeruginosa*. Dobijeni rezultati potvrđuju da poznata vrsta *R. canina* može biti veoma dobar prirodni antioksidans i preventivni antimikrobni agens.

Antioxidant and antimicrobial activity of *Rosa canina* L. extracts from Vlasina plateau

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The purpose of this study was to examine antioxidant and antimicrobial activity of *Rosa canina* L. extracts from Vlasina plateau. The fruits of roses are used primary for human nutrition (tea, marmelade, juice). Significant application is for treatment of colds, dry coughs and diarrhea. Fresh and wild growing fruits of rose were cut and extracted with two polar solvents, methanol and ethanol, using method of ultrasonic bath. The presence of phenol in extracts was confirmed by spectrophotometer, using Folin-Ciocalteau's reagent. Higher content of these compounds was observed in ethanolic extract (6.18 mg GA/g of dry extracts). Total content of flavonoids obtained with aluminum nitrate nonahydrate, showed approximately the same flavonoid concentrations in both extracts. Methanol extract was a more effective antioxidant agent using the (2,2-diphenyl-1-picrylhydrazyl) (DPPH) assay (0.54 mg/ml) in compare to ethanol extract (0.64 mg/ml). ABTS assay (2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) showed that the ethanolic extract had the higher free radical potential, with 0.20 mg VitC/g of dry extracts. Microdilution method was used for testing antimicrobial activity in the case of reaction on patogens isolated from food. Minimal inhibitory concentrations (MIC) were determined. *Pseudomonas aeruginosa* was the most sensitive strain to the tested extracts. The results obtained showed that well-known species *R. canina* can be used as very good natural antioxidants, as well as preventive antimicrobial agens.

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HZP13 / FHP13

Detekcija posttranslacionih modifikacija epitopa glavnih alergena kikirikija masenom spektrometrijom

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Alergija na kikiriki pogađa značajan deo svetske populacije, izazivajući simptome koji mogu varirati od blagih do opasnih po život. Ara h 1 i Ara h 3 su najzastupljeniji proteini semena kikirikija i njegovi glavni alergeni. IgE epitopi ovih proteina su dobro opisani u literaturi, ali se malo zna o njihovim posttranslacionim modifikacijama (PTM) i kakav one uticaj imaju na funkcionalne osobine ovih proteina. Cilj ovog rada je detekcija i karakterizacija PTM poznatih epitopa Ara h 1 i Ara h 3 metodama *bottom-up proteomike*.
Prečišćeni alergeni Ara h 1 i Ara h 3 su analizirani masenom spektrometrijom, primenom Top5 nLC-MS/MS metode na LTQ Orbitrap XL (Thermo Fischer Scientific). Dobijeni spektri su upoređeni sa Uniprot bazom podataka proteina kikirikija, hibridizovanom sa bazom kontaminirajućih proteina (Adventitious Proteins database, cRAP), softverskim paketom Peaks 8.5 (BSI, Canada). Sekvence epitopa Ara h 1 i Ara h 3 su preuzete iz baze podataka imunoepitopa (Immune Epitope Database – IEDB)
Na osnovu IEDB, Ara h 1 ima 327 peptidinih epitopa, u okviru kojih smo detektovali 8 PTM. Najučestalije PTM su hidroksilacija prolina i izmena iz Gln u Pyro-Glu. Ara h 3 ima 110 epitopskih sekvenci, sa 12 detektovanih PTM. Kao i kod Ara h 1 najučestalije su hidroksilacija prolina, i izmena iz Gln u Pyro-Glu, uz deamidaciju Asn i Gln. Aminokiselinski ostaci koji se nalaze u blizini, ili su mesta specifičnosti enzima, poput tripsina, su takođe detektovani kao modifikovani (npr. metilovani Lys i Arg, i acetilovani Lys), što može imati uticaj na digestibilnost i donekle alergenost ovih proteina.
Epitopi alergena kikirikija su nosioci post-translacionih modifikacija. Ovde prikazani rezultati predstavljaju prvi korak u rasvetljenju uticaja PTM na alergenost i digestibilnost proteina. Ovde su prikazani preliminarni podaci i neophodno je dublje proučavanje ovog fenomena kako bi se bolje razumeo uticaj koji modifikacije aminokiselinskih ostataka mogu imati na alergene hrane.

Detection of major peanut allergen epitope post-translational modifications by mass spectrometry

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Peanut allergies affect a large portion of world population causing reactions ranging from mild to severe that can lead to anaphylaxis and death. Seed storage proteins Ara h 1 and Ara h 3 are abundantly present in peanuts, and are known as major allergens. IgE epitopes of these allergens have been characterized, but little is known about how post-translational modifications (PTMs) affect their functional properties. Our aim was to investigate PTMs present on known epitopes of said proteins using bottom-up proteomics methods.
Purified peanut allergens (Ara h 1 and Ara h 3) were analysed by a Top5 nLC-MS/MS method by LTQ Orbitrap XL (Thermo Fischer Scientific, Germany). Spectra were compared to Uniprot derived Peanut protein database, hybridized with the Repository of Adventitious Proteins database (cRAP), using Peaks 8.5 software package (BSI, Canada). Epitopes were searched for possible PTMs by matching PEAKS PTM results with mapped positions of epitope sequences (Immune Epitope Database – IEDB).
According to IEDB Ara h 1 contains 327 peptide epitopes, within which we detected 8 likely PTMs. Most common PTMs found within Ara h 1 epitopes were hydroxylation Pro and pyro-Glu from Gln. Ara h 3 has 110 peptide epitope sequences, according to IEDB, with 12 likely PTMs detected by our method. Hydroxylation Pro, deamidation of Asn and Gln, and Pyro-Glu from Gln were found as most frequent in Ara h 3 epitopes. PTMs could be found in the vicinity of enzyme cleavage sites, which could have an impact on digestibility and allergenicity to some extent, for example methylation of Lys and Arg and acetylation of Lys in case of trypsin.
Peanut allergen epitopes are indeed carriers of PTMs. These results show promise in revealing a possible role PTMs could have on protein allergenicity and digestibility. Results shown here are preliminary, and further investigation is necessary in order to fully understand the impact protein modifications could have on their allergenic potential.

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HZP14 / FHP14

Koren biljke *Salvia verticillata* L. kao potencijalni dijetetski suplement i značajan izvor ruzmarinske kiseline

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Biljke roda *Salvia* koriste se kao aromatične, lekovite i začinske, kao i u industriji hrane, parfema i lekova. Poznato je da biosintetišu različite korisne metabolite, poput terpenpoida, flavonoida i fenola. *S.verticillata* poznata je u narodu kao lek za iskašljavanje, dezinfekciju usne duplje i zarastanje rana. Ekstrakti nadzemnog dela *S. verticillata* imaju visok sadržaj ruzmarinske kiseline i njenih derivata, kao i derivata salvianolične kiseline. Malo je podataka o hemijskom sastavu i biološkim aktivnostima ekstrakata korena. Etanolne ekstrakte korena napravili smo na tri načina: maceracijom, ekstrakcijom pomoću ultrazvuka (UE) i etnofarmakološkim modelom ekstrakcije (EE). Ekstrakti su pokazali visok sadržaj ukupnih fenolnih jedinjenja (207,16-313,90 mg GA/g suvog ekstrakta) i ruzmarinske kiseline (85,47-129,26 mg/g suvog ekstrakta). Model EE podrazumeva ekstrakciju usitnjenog suvog korena biljke deset puta većom zapreminom etanola (m/v) tokom 20 dana. Ovom ekstrakcijom postignut je najveći sadržaj ruzmarinske kiseline (129,26 mg/g suvog ekstrakta) određen visoko-efikasnom tečnom hromatografijom sa spektrofotometrijskom detekcijom. Metodom UE najbolje su ekstrahovana fenolna jedinjenja i flavonoidi, i postignut je najveći antioksidativni potencijal. Ekstrakti su pokazali visoku antioksidativnu aktivnost u poređenju sa referentnim antioksidantima, a u pojedinim slučajevima, UE i EE, veću aktivnost od askorbinske kiseline i troloksa. Nizak stepen antimikrobne aktivnosti zabeležen je kod sva tri ekstrakta sa minimalnim inhibitornim vrednostima za većinu ispitivanih bakterijskih i fungalnih vrsta od 20 mg/mL. Prezentovane informacije o ekstrakciji bioaktivnih jedinjenja iz korena *S. verticillata* će pomoći dalja ispitivanja ove biljke kao potencijalnog dijetetskog dodatka sa izraženom antioksidativnom aktivnošću.

Salvia verticillata L. root as potential dietary supplement and an important source of rosmarinic acid

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Salvia plants have been used as aromatic, medicinal and spicy herbs, as well as in the food, fragrance and drug industry. They were reported to biosynthesize various useful constituents, including terpenoids, flavonoids and other phenolics. *S.verticillata* L. is traditionally used as an expectorant, for disinfection of the oral cavity and wound healing. Some studies showed a high presence of rosmarinic acid, its derivatives and derivatives of salvianolic acid in *S. verticillata* aerial part extracts. However, there is little information on the chemical profiles and biological activities of *S. verticillata* root. Maceration process, ultrasound assisted extraction (UE) and ethnopharmacological model of extraction (EE) were applied for preparation of ethanolic extracts of root. All three extracts showed high total phenolic (207.16-313.90 mg GA/g dry extract) and rosmarinic acid (85.47-129.26 mg/g dry extract) contents. The EE model included extraction of powdered dried root material with ten times higher volume of ethanol (w/v) over 20 days. This extract possessed the highest rosmarinic acid content (129.26 mg/g dry extract) determined by HPLC-PDA method. The UE showed the best results in extraction of total phenolic compounds and total flavonoids, as well as the highest antioxidant potential. All extracts showed high antioxidant potential compared with standard antioxidants, and in some cases, EE and UE exhibited higher potential than ascorbic acid and Trolox. All studied extracts showed low antimicrobial potential with MIC values of 20 mg/mL for most of tested bacterial and fungal strains. Presented information about extraction of bioactive constituents from *S. verticillata* root will aid further research of this plant as a potential dietary supplement with strong antioxidant activity.

Пирогалол, структурни мотив у развоју новог хемотерапеутика

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У овом раду испитиван је цитотоксични потенцијал галне киселине и њеног структурног мотива пирогалола на малигне ћелије рака плућа (A-549) и нормалне (здраве) ћелије фибробласта (MRC-5). У почетном скринингу етанолних екстраката семенки грожђа различитих сорти винове лозе, издвојиле су се семенке аутохтоне сорте Прокупац, како по цитотоксичности (IC_{50} 21,37±1,11 μg/mL, A-549), тако и по садржају укупних фенола (104,05±3,68 g еквивалената галне киселине/kg сувог узорка). За потребе даљег рада одабрана је гална киселина као најзаступљенија хидроксибензоева киселина у истакнутим семенкама (296,68±14,01 mg/kg сувог узорка). Ова киселина, међутим, показала се као слаб цитотоксичан агенс на малигне ћелије A-549 (IC_{50} 200±16 μM, 96 h), у поређењу са пирогалолом (IC_{50} 20,05±1,12 μM, 96 h), супстанцом која није била цитотоксична на ћелије MRC-5.

Pyrogallol, a structural motif in development of new chemoterapeutic

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This study aimed to investigate cytotoxic potential of gallic acid and pyrogallol (its structural motif) towards malignant lung cells (A-549) and normal (healthy) fibroblast cells (MRC-5). In the initial screening of the ethanol extracts of grape seeds belonging to different grapevine varieties, the grape seeds of autochtonous variety Prokupac stood out both regarding their cytotoxicity (IC_{50} 21.37±1.11 μg/mL, A-549, 96 h) and total phenolic content (104.05±3.68 g gallic acid equivalents/kg of dry sample). As the most abundant hydroxybenzoic acid in the highlighted grape seeds (296.68±14.01 mg/kg of dry sample), gallic acid was the subject of further research work. However, this acid was found to be a weak cytotoxic agent towards malignant A-549 cells (IC_{50} 200±16 μM, 96 h), compared to pyrogallol (IC_{50} 20.05±1.12 μM, 96 h), the substance that practically showed a lack of any cytotoxicity towards MRC-5 cells.

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HZP16 / FHP16

Transgalktolizacija laktoze pomoću imobilisanog enzima u pneumatskom reaktoru sa spoljasnjom recirkulacijom

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Enzimi, slobodni ili imobilisani, se često koriste kao katalizatori u različitim biohemijskim procesima. Imobilizacija enzima obezbeđuje zaštitu enzima od smicajnih sila, lakše izdvajanje enzima iz reakcione smeše i njegovu ponovnu upotrebu. Pored toga, primena imobilisanih enzima omogućuje bolju kontrolu procesa, kao i kontinualni rad reaktora. Za procese u kojima se koriste imobilisani enzimi mogu se primeniti različiti tipovi reaktora, ali su pneumatski reaktori sa recirkulacijom posebno pogodni. Naime, usled osetljivosti enzima na uslove u mikrookuženju neophodno je obezbediti da ti uslovi budu striktno regulisani da ne bi došlo do oštećenja enzima. Pneumatski reaktori sa recirkulacijom to pružaju a uz to primena ovog tipa reaktora omogućuje i niske produkcione troškove, lak rad i jednostavno uvećanje razmera.
U ovom istraživanju ispitivana je biohemijska reakcija transgalaktozilacije laktoze u cilju dobijanja vredih prebiotskih jedinjenja galakto-oligosaharida (GOS) pomoću komercijalnog enzima *β*–galactosidaze iz *Aspergillus oryzae,* imobilisanog na česticama jonoizmenjivačke smole srednjeg prečnika 0,7 mm. Laboratorijski pneumatski reaktor sa recirkulacijom koji je bio korišćen imao je cevi prečnika 25 mm, visinu od 0,2 m i širinu 0,15 m.
Dobijeni rezultati su pokazali da je stepen konverzije dobijen u pneumatskom reaktoru sa recirkulacijom isti kao i u šaržnom laboratorijskom reaktoru, s tim što se isti stepen konverzije brže dostiže u ovom tipu reaktora usled boljeg prenosa mase i povećanog afiniteta prema reakciji transgalaktozilacije. Pored toga, u pneumatskom reaktoru sa recirkulacijom nije došlo do smanjenja aktivnosti enzima zbog povoljnih uslova u mikrookruženju.
Ovo ispitivanje je pokazalo da je primena pneumatskog reaktora sa recirkulacijom za proces transgalaktosilacije pomoću imobilisane *β*-galactosidaze obećavajuća opcija za komercialnu proizvodnju galakto-oligosaharida.

Transgalactosylation of lactose with immobilized enzyme in external airlift reactor

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Enzymes in immobilized form are commonly utilized as catalysts in different processes since it offer the possibility to control product formation, protect enzyme from shear stress, continuous work of reactor, easyer separation from reaction mixture and reusability and loger life of enzime. Among different reactors that can be used for those systems airlift reactor is very attractive due to its numerous advantages. Namely, enzymes are very sensitive to unfavorable conditions achieving of favorable microenvironment, in order to increase productivity of the desired products, is very challenging task for those systems. Airlift rector for those systems enable regulated and reproducible microenvironment, low production costs, easy handling and scalability, and safe production (in terms of low risks for contamination).
The reaction examinated in this study was transgalactosylation of lactose by enzyme β –galactosidase from *Aspergillus oryzae* immobilized on ion-exchange resin particles of 0.7 mm average diameter. A bench-scale external loop airlift rector, with internal dia. of 25 mm, 0.2 m high, and 0.15 m wide was use to carry out this reaction.
The experimental results show that conversion degree of enzyme-catalyzed reaction in arilift reactor is as high as in a laboratory-scale batch reactor, but reaction kinetics is faster in airlift reactor. It is anticipated that the higher conversion is reached due to enhanced mass transfer between the phases in the airlift. In addition, lifetime of enzyme in airlift reactor was found to be much longer in airlift than in other reactors used probably due to the favorable conditions acieved in this reactor.
Results obtained in this investigation demonstrates that transgalactosylation with immobilized β-galactosidase in a batch and continuous external airlift reactor are the promising options for improved commercial production of galacto-oligosaccharides.

Efekat devičanskog kokosovog ulja na sastav mikrobite kod pacova

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Kokos je poznat kao jedan od najpopularnijih prirodnih izvora masnih kiselina kratkih i srednjih lanaca sa dominantnom laurinskom kiselinom. Smatra se da devičansko kokosovo ulje (VCO) ima efekte na smanjenje gojaznosti, a zbog prisustva laurinske kiseline poseduje i antimikrobni efekat. Mikrobiota creva sastoji se od različitih populacija fakultativnih i obligatnih anaeroba sa širokim spektrom metaboličkih aktivnosti, čiji produkti mogu biti esencijalni nutrijenti koje koristi domaćin. Izmena u sastavu mikrobiote je povezana sa brojnim zdravstvenim poremećajima i zbog toga je istraživanje uticaja hrane na njen oporavak u ekspanziji. Cilj ovog rada je ispitivanje efekta VCO na promenu sastava mikrobiote creva zdravih pacova, kao i onih kod kojih je dijabetes indukovan aloksanom (Alx). Eksperimentalni model sastavljen je od četiri grupe životinja, koje se međusobno razlikuju po kombinacijama tretmana sa VCO i Alx. Uporedna *in vitro* analiza brojnosti i sastava mikrobiote creva izvršena je sekvenciranjem 16S marker gena na MiSeq-u, Ilumina. VCO suplementacija je bila pozitivno korelisana sa povećanjem broja bakterija u familijama Lactobacillaceae (*Lactobacillus*) i Erysiphelotrichaceae (*Allobaculum*), dok je efekat na brojnost bakterija iz familije Prevotelaceae (*Prevotella*) jasno zavisio od glikemijskog statusa: kod zdravih životinja VCO je značajno smanjio njihovu brojnost, ali je kod dijabetičnih pacova efekat bio suprotan. Zanimljivo, Bifidobacteriaceae (*Bifidobacterium*), i to u izuzetno visokom procentu, su zapažene samo u VCO grupi. S druge strane, efekat na smanjenje brojnosti u familiji Spirochaetaceae (*Treponema*) je uočen u VCO i Alx+VCO grupama, a u familiji Turicibacteriaceae (*Turicibacter*) samo u VCO grupi. Ovim radom je pokazan pozitivan efekat devičanskog kokosovog ulja na mikrobiotu creva pacova, uz značajno povećanje brojnosti korisnih bakterija iz rodova *Lactobacillus, Allobaculum* i *Bifidobacteria*.

Effect of virgin coconut oil supplementation on the microbiota composition in rats

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Coconut is known as one of the most popular natural sources of fatty acids of short and medium chains with lauric acid as dominant. Virgin coconut oil (VCO) is considered to have anti-obesity effect, and additionally antimicrobial due to presence of lauric acid. The intestine microbiota consists of diverse populations of facultative and obligatory anaerobic microorganisms with a wide range of metabolic activities that provide essential nutrients for the host. Its disturbance is associated with different health disorders. Consequently, investigation of foods influence on its recovery is in great expansion. The aim of this work was to evaluate the effect of VCO on the gut microbiota composition changes in non-diabetic and alloxan-induced diabetic rats. The experimental model was compiled of four groups of rats, differing from each other by the combinations of alloxan (Alx) and VCO treatments. Abundance and composition of the caecal microbiota was comparatively investigated *in vitro*, under the 16S rDNA NGS sequencing illumina platform. VCO supplementation was positively correlated with families Lactobacillaceae (*Lactobacillus)* and Erysiphelotrichaceae (*Allobaculum*), whiles the effect on Prevotelaceae (*Prevotella*) was clearly depended on the glycemic status: in healthy animals VCO extremely decreased its abundance, but in diabetic ones the effect was opposite. Interestingly, Bifidobacteriaceae (*Bifidobacterium*) with an extremely high percentage was observed only in VCO group, indicating positive effect of VCO. On the other side, the reducing effect on Spirochaetaceae family (*Treponema*) was observed in VCO and Alx+VCO groups, and additionally on Turicibacteriaceae (*Turicibacter*) in VCO group. In conclusion, in rat model we proved the positive effect of virgin coconut oil on the caecum microbiome, with a significant increase in the abundance of beneficial *Lactobacillus, Allobaculum* and *Bifidobacteria* species.

HZP18 / FHP18

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Antiradikalska aktivnost avarola

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Avarol predstavlja seskviterpenoidni hidrohinon izolovan iz morskog sunđera *Dysidea avara* (Schmidt, 1864). Poseduje širok spektar bioaktivnosti, može da prolazi kroz krvno-moždanu barijeru, a nije toksičan za ljude. Antiradikalska aktivnost ovog terpenoidnog jedinjenja na hidroksilni, superoksid-anjon, askorbil i azot-monoksidni radikal praćena je pomoću elektronske paramagnetne rezonantne (EPR) spektroskopije u uslovima *in vitro*. Dobijeni rezultati ukazuju da avarol snažno deluje na hidroksilni (91,1 %) i superoksid-anjonski radikal (92,7 %). Dalja istraživanja trebalo bi usmeriti ka analozima avarola poreklom iz jestivih algi koje nastanjuju Svetsko more.

Antiradical activity of Avarol

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Avarol represents a sesquiterpenoid hydroquinone isolated from the marine sponge *Dysidea avara* (Schmidt, 1864). It possesses a plethora of bioactivities, can cross the blood-brain barrier and shows a lack of toxicity for humans. Antiradical activity of this terpenoid compound towards hydroxyl, superoxide-anion, ascorbyl and nitric oxide radicals was screened by electron paramagnetic resonance (EPR) spectroscopy at *in vitro* conditions. The obtained results indicate that Avarol effectively scavenged hydroxyl (91.1 %) and superoxide-anion (92.7 %) radicals. Further investigations should be directed towards Avarol analogs originated from edible algae inhabiting the World Sea.

In vitro ispitivanje antikancerogenih osobina voćnih nusprodukata

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Poslednjih godina sve je veći interes za pronalaženje jeftinih i obnovljivih izvora bioaktivnih jedinjenja prirodnog porekla. Ekstrakcija jedinjenja sa nutritivnim i lekovitim svojstvima iz voćnih nusprodukata, koji trenutno predstavljaju bio-otpad prehrambene industrije, postala je fokusna tačka istraživanja. Objavljena istraživanja o ekstraktima voćnih nusprodukata pokazala su njihove obećavajuće antioksidativne i antikancerogene osobine. U ovom radu, bioaktivna jedinjenja iz peteljki trešnje i višnje su ekstrahovana subkritičnom vodom. Antikancerogena aktivnost ekstrakata procenjena je na osnovu inhibicije metaboličke aktivnosti ćelija raka izmerene MTT testom. Korišćene su dve histološki različite ćelijske linije raka: RD ćelijska linija izvedena iz humanog rabdomiosarkoma (RD) i ćelijska linija izvedena iz mišijeg fibroblasta (L2OB). Eksperimentalno određene IC_{50} vrednosti ekstrakta peteljki višnje za RD i L2OB ćelije su 11,40 i 9,69 mg/mL, dok su za ekstrakt peteljki trešnje ove vrednosti 10,55 i 8,87 mg/mL. Visoka antikancerogena aktivnost dobijenih ekstrakata može se odnositi na karakterističan fitohemijski sastav i formiranje novih bioaktivnih jedinjenja tokom tretmana sa subkritičnom vodom. Rezultati našeg istraživanja ukazuju da bi kvalitativna i kvantitativna hemijska analiza subkritičnih vodenih ekstrakta peteljki trešnje i višnje bila opravdana u cilju identifikovanja potencijalnih antikancerogenih jedinjenja.

In vitro screening of anticarcinogenic properties of fruit by-products

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In last decade, there has been an increased interest in the search of inexpensive and renewable sources of bioactive compounds from natural sources. The extraction of compounds with nutritional and medicinal properties from fruit by-products, that currently represents bio-waste of food industry, has become focal point of the research. Published studies on extracts of fruit processing by-products have shown promising antioxidant and anticarcinogenic properties. In this study, the bioactive compounds from sweet and sour cherry stems were extracted by subcritical water (SWE). The cell growth inhibitory activity of extracts was evaluated *in vitro* by MTT assay. Two histologically different cell lines were used: RD cell line derived from human rhabdomyosarcoma (RD) and cell line derived from murine fibroblast (L2OB). Experimentally determined IC_{50} values of sour cherry stems extract against RD and L2OB cells were 11.40 and 9.69 µg/mL, respectively. While in the case of sweet cherry stems these values were 10.55 and 8.87 µg/mL. High anticarcinogenic activity of obtained extracts could be related to characteristic phytochemical composition and neoformation of bioactive products during the treatment with subcritical water.
Our results indicate that qualitative and quantitative chemical analysis of subcritical water extracts of cherry stems is justified for the identification of potential bioactive ingredients.

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In vitro antilisterijalni efekat etarskih ulja *Juniperus communis* i *Satureja montana*

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Listeria monocytogenes je patogen hrane, izrazito tolerantan prema različitim faktorima spoljašnje sredine, uključujući temperaturu, što doprinosi čestoj pojavi u namirnicama. Cilj ovog rada bio je ispitivanje antibakterijskog potencijala etarskih ulja *Juniperus communis* (JC-EO) i *Satureja montana* (SM-EO), kao i njihova hemijska karakterizacija. Antibakterijski efekat je ispitivan prema referentnom ATCC 19111 soju, kao i prema primoizolatima sa junećeg trupa (LMB), lososa (LMS) i odvodnog tunela vode u klanici (LMT). Primenjeni su mikrodilucioni testovi (MIC i metoda šahovske table) i metoda vremenski zavisne inhibicije rasta, koja se izvodi u makro-volumenima.

GC-MS analiza je ukazala da su dominantni sastojci JC-EO α-pinen (47,8%) i sabinen (11,0%), a SM-EO karvakrol (30.7%) i timol (18.0%). Minimalne inhibitorne koncentracije (MIC) oba ulja iznosile su 0,5-1%, dok su minimalne baktericidne koncentracije bile 1-4% za JC-EO i 1% za SM-EO. Metoda šahovske table, primenjena za analizu kombinovanog dejstva oba ulja, ukazala je na sve tipove interakcije u slučaju primoizolata i pretežno indiferentni efekat prema ATCC 19111 soju. Metoda vremenski zavisne inhibicije rasta potvrdila je dobijene tipove interakcije. Pored toga, analizom kriva inhibicije rasta i izračunavanjem stopa rasta za svaku od njih, utvrđene su koncentracije ulja koje su dovele do odsustva i rasta i inhibicije (MIC vrednosti kriva, cMIC). One su bile značajno niže od vrednosti MIC dobijenih u mikrodilucionoj metodi, što se pripisuje različitim uslovima aerobioze ostvarenim u mikro i makro volumenima, odnosno metaboličkim razlikama koje ih prate.

U zaključku možemo konstatovati da etarska ulja *J. communis* i *S. montana* mogu efikasno inhibirati rast *L. monocytogenes*. Dalja evaluacija njihovog antibakterijskog potencijala *in vitro* i *in situ* u hrani može se preporučiti za buduća istraživanja.

Antilisterial activity of *Juniperus communis* and *Satureja montana* essential oils screened *in vitro*

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Listeria monocytogenes is a food pathogen widely tolerant to different environmental factors including temperature. This is the main factor contributing to frequent food contamination. The aim of this study was to examine the antibacterial effect of essential oils of *Juniperus communis* (JC-EO) and *Satureja montana* (SM-EO) against *L. monocytogenes*, as well as to determine their chemical composition. Antibacterial effect was determined against reference ATCC 19111 and three *L. monocytogenes* primoisolates: LMB, LMS and LMT, isolated from beef carcass, salmon and slaughterhouse water drainage tunnel, respectively. It was estimated in microdilution MIC and checkerboard assays, and in time kill assay, performed in macro-volumes.

The chemical analysis, determined by GC-MS, revealed that the most abundant constituents were α-pinene (47.8%) and sabinene (11.0%) in JC-EO, and carvacrol (30.7%) and thymol (18.0%) in SM-EO. Minimal inhibitory concentrations (MICs) of both EOs were in the range 0.5-1%. Minimal bactericidal concentrations were determined to be 1-4% for JC-EO, and 1% for SM-EO. Checkerboard assay, performed in order to analyze the combined effect of the oils, revealed all types of interactions for tested primoisolates, and mostly indifferent effect against ATCC 19111 strain. Time kill assay confirmed the obtained mode of interactions. In addition, calculation of growth rates was used to estimate the concentrations inducing neither growth, nor killing effect (curve MIC values, cMICs). They were multifold lower compared to MICs obtained in microdilution assay. This could be adressed to different aerobiosis realized in micro- and macro-volumes, and consequent metabolic differences.

In conclusion, *J. communis* and *S. montana* essential oils and their combinations could be the efficient vehicles inhibiting the growth of *L. monocytogenes*. Further evaluation of their antibacterial potential, both *in vitro* and *in situ* in foods, could be suggested.

HZP21 / FHP21

Effects of gamma radiation on phenolic composition, cytotoxicity, antibacterial and virucidal activities of two medicinal plants

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The consumers' interest for a healthier diet and the use of natural products in the prevention and/or treatment of health problems has triggered an intensive search for bioactive plant compounds. Plants are a good source of phenolic compounds, terpenoids, alkaloids, quinones, carotenoids, sterols, glucosinolates and other compounds, which provide health benefits due to their wide range of biological properties.

This work aimed to evaluate the effects of gamma radiation on the phenolic composition, cytotoxicity, virucidal and antimicrobial properties of *Aloysia citrodora* L. and *Mentha x piperita* L. infusions. Gamma radiation treatment was performed in a ^{60}Co chamber, applying the doses of 1 and 10 kGy and the results were compared with the control sample (0 kGy). The phenolic compounds profile was obtained by HPLC-DAD-ESI/MS and the cytotoxicity was evaluated in human tumour cell lines and in a primary cell culture. For virucidal efficacy evaluation, MNV-1 and HAdV-5 viral titers were determined by plaque assay in Raw264.7 and A549 cell lines, respectively. The antibacterial activity was evaluated against Gram-negative and Gram-positive bacteria. Radiation treatment has been shown to cause different effects on phenolic concentrations and virucidal efficacy, depending on the plant species studied, the virus and the absorbed dose. In cytotoxicity assay *A. citrodora* did not reveal significant statistically differences considering the different doses applied, however *M. piperita* at 10 kGy stood out with the highest cytotoxic potential in all tested cell lines. Regarding antibacterial assays, *S. aureus* was the only bacteria that was sensible to the infusions of non-irradiated and 1 kGy irradiated in both species. Thus, this study contribute to a wider knowledge of the effects of gamma irradiation on several relevant bioactive potentials of some aromatic and medicinal plants and showed that gamma radiation is a technique recommended for these matrices.

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HZP22 / FHP22

Suplementacija sokom od aronije pre simulacije polumaratonske trke – da li može povećati ukupni antioksidativni status kod rekreativnih trkača?

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Maratonci mogu biti pod većim kardiovaskularnim rizikom usled povećanog nivoa oksidativnog stresa nakon izlaganja intenzivnoj fizičkoj aktivnosti (kao što je trčanje polumaratonske trke). Iz tog razloga smo istražili da li jednoročno konzumiranje soka od aronije može dovesti do pozitivnih promena u oksidativnom statusu nakon simulacije polumaratonske trke.
10 rekreativnih trkača (starih 30.8±2.3 godine) su učestvovali u jednostruko slepoj, randomiziranoj, placebo kontrolisanoj studiji unakrsnog dizajna. Intervencija se sastojala od 200 ml soka od aronije ili placeba koji nije sadržao polifenole, koje su ispitanici konzumirali nakon kalorijski identičnog obroka. Pratili smo promene u totalnom antioksidativnom statusu u četiri tačke: početnoj, 15 minuta, sat vremena i 24 sata nakon trke. Primenili smo dvofaktorsku ANOVU sa ponavljanjem u statističkom softveru SPSS verziji 23.
Kod muškaraca koji su pili sok od aronije, ukupni antioksidativni kapacitet je porastao odmah i jedan sat nakon trke, dok se vratio na početne vrednosti 24 sata nakon trčanja. Sa druge strane, u placebo grupi nismo zapazili nikakvu promenu u toku prvog sata nakon trke, da bi nakon 24 časova došlo do pada od 17% u poređenju sa početnom vrednošću. Međutim, nijedna od ovih promena nije bila statistički značajna.
Iako nismo zapazili nijednu statistički značajnu promenu između dve eksperimentalne grupe, ukupni antioksidativni status je pokazao bolji profil promene kod trkača koji su konzumirali sok od aronije pre trke (u poređenju sa trkačima koji su pili placebo). Ova zapažanja se moraju potvrditi u većem uzorku.

Aronia juice consumption before simulation of a half-marathon race - can it enhance the total antioxidant status in recreational runners?

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Marathon runners may be at higher risk of adverse cardiovascular events due to alleviated oxidative stress after strenuous physical activity (such as running a half-marathon). Therefore, we investigated whether Aronia juice consumption can acutely induce favourable changes in the oxidative status after simulation of a half-marathon race.
Ten recreational male runners (30.8±2.3 years old) were involved in a single-blinded, randomized, placebo-controlled, crossover study. The intervention consisted of 200 ml Aronia or polyphenol-free placebo juice which was consumed after calorically identical breakfast. We followed the change in the plasma total antioxidant capacity at 4 time-points: baseline (before intervention), 15 minutes, 1 hour and 24 hours after the half-marathon race simulation. Two-way repeated measures ANOVA was carried out in statistical package SPSS Ver.23.
In men who drank Aronia juice, the total antioxidant capacity increased immediately and one hour after the race, while it returned to the basal values after 24 hours. On the other hand, during the first hour after running, there was almost no change in the antioxidant capacity in men who received placebo juice, while after 24 hours we observed a 17% decrease compared with the baseline. However, none of these changes reached statistical significance.
We observed no statistically significant differences between the two experimental groups in their total antioxidant status after the treatments. However, the men who drank Aronia juice prior to the half-marathon race exerted a more favourable pattern of change compared with the men who drank placebo. These observations need confirmation in a larger sample.

HZP23 / FHP23

Sadržaj beta-glukana i antioksidativna aktivnost dodataka ishrani na bazi gljiva

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Na tržištu se nalazi veliki broj dijetetskih suplemenata na bazi gljiva, koji su deklarisani kao dodatni izvori biološki aktivnih jedinjenja u ishrani, sa brojnim pozitivnim zdravstvenim efektima. Osnovni cilj ovog rada bio je da se odredi sadržaj beta-glukana i ukupnih polifenola, kao i izvrši komparativna analiza *in vitro* antioksidativne aktivnosti odabranih dodataka ishrani na bazi gljiva sa našeg tržišta. Sadržaj ukupnih, α- i β-glukana određen je komercijalnim enzimskim testom (*Mushroom and Yeast β-glucan Assay, K-YBGL, Megazyme*). Sadržaj ukupnih polifenolnih jedinjenja je određen *Folin-Ciocalteu* metodom, a procena antioksidativnog potencijala različitih ekstrakata dodataka ishrani izvršena je *FRAP, DPPH, ABTS* i *CUPRAC* testovima. Na osnovu dobijenih rezultata, računskim putem izračunate su vrednosti antioksidativnog kompozitnog indeksa (*ACI*). Sadržaj ukupnih glukana je bio u rasponu od 5,0 do 43,3 g/100 g, α- glukana od 0,13 do 2,4 g/100g, a vrednosti sadržaja β-glukana su iznosile od 19,8 do 41,9 g/100g. U pojedinačnom doziranom obliku, sadržaj β-glukana u proseku iznosi 269,75 mg. U svim analiziranim ekstraktima, utvrđena je pozitivna korelacija između sadržaja ukupnih polifenola i vrednosti *ACI*. Dobijeni rezultati, potvrđuju razlike u sadržaju β-glukana i ukupnih polifenolnih jedinjenja u komercijalnim dodacima ishrani na bazi gljiva, kao i u njihovoj *in vitro* antioksidativnoj aktivnosti. Standardizacija sirovina i ekstrakata je neophodna u cilju proizvodnje kvalitetnih, a time i efikasnih i bezbednih dodataka ishrani na bazi gljiva.

Beta-Glucan Content and Antioxidant Activity of Mushroom Supplements

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Medicinal mushroom supplements are widely marketed as sources of different bioactive compounds and claimed with many beneficial health effects. This study was conducted to evaluate and compare β-glucan contents and *in vitro* antioxidant activity of mushroom supplements on the Serbian market. The content of total, α- and β-glucan were determined using the Megazyme Mushroom and Yeast Beta-Glucan kit. Folin-Ciocalteu method is used to estimate the total phenolic contents. The antioxidant activities of different extracts of mushroom supplements were tested using DPPH, FRAP, ABTS and CUPRAC assay, while antioxidant composite index (ACI) was calculated. The total glucan content was in a range from 5.0 to 43.3 g/100g. The α-glucan content in analyzed samples was lower, (0.13-2.4 g/100g), compared to β-glucan content (19.8-41.9 g/100g). A single dose of mushroom supplements contains β-glucan in an average of 269.75 mg. In all types of extracts, a positive correlation between the total content of the polyphenolic compounds and the ACI value was observed. The obtained results indicate the differences in the content of β-glucan, total phenolic content and *in vitro* antioxidative activities among commercial mushroom supplements and need to their standardization in order to ensure the quality, as well as effectively and safely use of mushroom supplements.

Od mediteranskog sunđera do antitumorskog sastojka hrane

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Cilj ovog rada bio je da se *in vitro* ispita odnos hemijske strukture i citotoksične aktivnosti avarola i njegovih strukturnih elemenata (hidrohinon i terpenoidni ostatak) na ćelijama U-251 MG humanog glioma, kao i selektivnost citotoksičnog delovanja (U-251 MG vs. U-87 MG). Citotoksičnost je određena MTT testom, a profil ćelijskog ciklusa protočnom citometrijom. Ova studija ukazala je na visok potencijal hidrohinona, sastojka hrane prirodnog porekla, u otkriću novih i efikasnijih hemoterapeutika za maligne gliome uključujući glioblastome.

From a Mediterranean sponge species to an antitumour food ingredient

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This study aimed to screen *in vitro* structure-activity relationship (along with selectivity, U-251 MG vs. U-87 MG cells) using avarol (followed by its structural elements, hydroquinone and terpenoid moiety) and the human malignant glioma U-251 MG cells. Cytotoxicity and cell cycle analysis were determined using a colorimetric MTT assay and flow cytometry, respectively. This study has demonstrated a significant potential of hydroquinone, naturally occuring food ingredient, in the design of new and more effective chemotherapeutic(s) specifically targeting malignant gliomas including glioblastomas.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZP25 / FHP25

Akutni efekat crvenog vina na osobine kardiovaskularnih ritmova kod zdravih osoba

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Korisni efekti dugotrajnog uzimanja crvenog vina na kardiovaskularni sistem poznati su od davnina. Njihovo dejstvo zavisi od vrste grožđa, načina dobijanja vina, kao i odnosa zastupljenosti različitih korisnih komponenti. Međutim, vrlo malo se zna o neposrednom, akutnom efektu male količine crvenog vina na kardiovaskularni sistem. Stoga je cilj naših ispitivanja bio da analizom kardiovaskularnih signala, EKG-a i krvnog pritiska, saznamo nešto više o akutnom dejstvu crvenog vina na kardiovaskularni sistem i njegove regulatorne mehanizme. U ispitivanju je učestvovalo četrnaest zdravih adolescenata ono je obuhvatalo dva eksperimenta. Prvi eksperiment bio je sa uzimanjem 200 ml crvenog vina (*Caberne Suvignon, Radovanović 2008*), a drugi sa uzimanjem kontrolnog alkoholnog pića sa jednakom koncentracijom alkohola. U oba eksperimenta EKG je sniman u ležećem položaju, 20 minuta pre i 60 minuta posle uzimanja pića, iz koga su ekstrahovani nizovi RR intervala. Istovremeno, na svakih 10 minuta, beleženi su sistolni i dijastolni krvni pritisak. U analizi vremenskih nizova RR intervala primenili smo linearne (spektralna analiza) i nelinearne metode (DFA i entropija) sa ciljem kvantifikovanja promena na nivu autonomne srčane kontrole. Neposredan efekat vina i kontrolnog alkoholnog pića na srčanu frekvencu i krvni pritisak bio je jednak; signifikantan skok i zatim postepen pad na početnu vrednost. Međutim, uočili smo da vino i kontrolno piće imaju različit prolongirani efekat. Vino značajno smanjuje krvni pritisak ($p < 0,05$) i značajno utiče na dinamiku RR intervala, kao i njihovu kompleksnost. Mada ovim eksperimentom nismo mogli da ukažemo da li su ove promene rezultat korisnih supstanci iz vina i/ili njihove sinergije sa alkoholom, možemo da pretpostavimo da su promene na kardiovaskularnom sistemu integrativne prirode. Akutni efekat uzimanja jedne čaše crvenog vina rezultuje značajnim promenama u autonomnoj kontroli kardiovaskularnog sistema.

The acute effect of red wine on the properties of cardiovascular rhythms in healthy subjects

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The beneficial effects of long-lasting red wine intake on the cardiovascular system have been known since ancient times. Their effect depends on the type of grapes, the way wine is obtained, and the amount of various useful components. However, very little is known about the immediate, acute effect of a small amount of red wine on the cardiovascular system. Therefore, the aim of our examinations was to find out more about the acute effects of red wine on the cardiovascular system and its regulatory mechanisms by analyzing cardiovascular signals, ECG and blood pressure. Fourteen healthy young men participated in the study and it included two experiments. The first experiment was the taking of 200 ml of red wine (*Caberne Suvignon, Radovanović* 2008), and the second with the taking of a controlled alcoholic beverage with the same concentration of alcohol. In both experiments, the ECG was recorded in the lying position, 20 minutes before and 60 minutes after taking the drink, from which the RR interval series were extracted. At the same time, every 10 minutes, systolic and diastolic blood pressures were recorded. In the analysis of the time series of the RR interval we applied linear (spectral analysis) and nonlinear methods (DFA and entropy) with the aim of quantifying their changes.
The direct effect of wine and control alcoholic drink on heart rate and blood pressure was the same; a significant jump and then gradually drop to the initial value. However, we noticed that wine and control drink have a different prolonged effect. Wine significantly reduces blood pressure ($p<0.05$) and significantly influences the dynamics of RR interval series, as well as their complexity. Although this experiment did not allow us to point out whether these changes are the result of useful wine supplements and /or their synergy with alcohol, we can conclude that changes to the cardiovascular system are integrative. The acute effect of taking a glass of red wine reveals significant alterations in the autonomic control of the cardiovascular system.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZP26 / FHP26

Anti-kvorum aktivnost dopamina i srodnih jedinjenja

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Cilj ovog rada bio je da se po prvi put ispita anti-kvorum aktivnost dopamina (sastojka hrane) i njemu srodnih jedinjenja u hemijskom smislu na bakterijski soj *Pseudomonas aeruginosa* PAO1, radi mogućeg otkrića nove vodeće strukture (eng. lead compound) u dizajnu efikasnog antibiotika. Na osnovu eksperimentalno dobijenih podataka može se zaključiti da bi, na prvom mestu, derivati homovanilinske kiseline i norepinefrina (koji, takođe, predstavljaju sastojke hrane) mogli da inspirišu dizajn novog leka (antibiotika) za ovu multirezistentnu bakteriju.

Anti-quorum sensing activity of dopamine and related compounds

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The aim of this work to screen for the first time anti-quorum sensing activity of dopamine (a food ingredient) and related compounds towards *Pseudomonas aeruginosa* PAO1, due to the possible discovery of a new lead compound for design of an effective antibiotic. The obtained experimental data suggest that derivatives of homovanillic acid and norepinephrine (compounds that also represent food ingredients) might be used as the platform of a new drug (antibiotic) for this multiresistant bacterium.

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HZP27 / FHP27

Osvrt na anti-acetilholinesterazni potencijal gljiva *Agrocybae aegerita* (Briganti) Fayod i *Pleurotus ostreatus* (Jacq.) P. Kumm., 1871

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Uprkos enormnim sredstvima koja se već izvesno vreme ulažu u pronalazak odgovarajućeg tretmana za obolele od Alchajmera, palijativna terapija praktično još uvek predstavlja jedini oblik "lečenja". Stoga je potraga za novim inhibitorima acetilholinesteraze prirodnog porekla od posebnog značaja, pogotovo onih koji nisu alkaloidne hemijske prirode, zbog nepoželjnih efekata. U okviru date studije, kao obećavajući izvori potencijalno novih inhibitora pomenutog enzima, izdvojio se metanolni ekstrakt gljive *Agrocybae aegerita* (IC_{50} = 0,21 mg/mL), kao i vodeni ekstrakt gljive *Pleurotus ostreatus* (IC_{50} = 0,24 mg/mL). Kako su obe vrste jestive i cenjene zbog svog prijatnog mirisa i ukusa, s pravom se može pretpostaviti njihova medicinska upotreba, ukoliko dalje studije potvrde uočenu bioaktivnost i u uslovima *ex vitro* i u uslovima *in vivo*.

An insight into anti-acetylcholinesterase potential of the fungi *Agrocybae aegerita* (Briganti) Fayod & *Pleurotus ostreatus* (Jacq.) P. Kumm., 1871

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In spite of tremendous means that have been invested into the disovery of an appropriate treatment for Alzheimer's patients for a while, palliative therapy still does represent the only way for its "curing". Consequently, the search for novel acetylcholinesterase inhibitors of natural origin is of very importance, in particular those not belonging to the class of alkaloids, due to their side effects. Herein methanol extract of the fungus *Agrocybae aegerita* (IC_{50} = 0.21 mg/mL) and water extract of the fungus *Pleurotus ostreatus* (IC_{50} = 0.24 mg/mL) stood out as promising resources of potentially new inhibitors of the aforementioned enzyme. Since both fungi represent edible species that are highly regarded due to pleasant smell and taste, their medicinal use is much likely, if further studies confirm the observed bioactivity both at *ex vitro* and *in vivo* conditions.

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HRANA I ZDRAVLJE / FOOD AND HEALTH

HZP28 / FHP28

EFEKAT SUPLEMENTACIJE OKTAKOZANOLOM NA INDEKS OKSIDATIVNOG STRESA KOD PACIJENATA NA TERAPIJI ATORVASTATINOM

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Oktakozanol, glavna komponenta polikozanola, može imati pozitivne efekte u tretmanu dislipidemija kako u primarnoj tako i u sekundarnoj prevenciji. Statini predstavljaju najčešće primenjivane lekove za tretman hiperholesterolemija. Od velike važnosti su i drugi plejotropni efekti statina, pri čemu je jedan od njih i modulacija oksidativnog stresa.
Cilj ove studije bio je ispitati moguće korisne efekte suplementacije oktakozanolom na indeks oksidativnog stresa (oxy-skor) kod pacijenata na hroničnoj terapiji atorvastatinom.
Randomizovana, paralelna, dvostruko slepa, placebo kontrolisana studija obuhvatila je 87 pacijenata (starosti 40-80 godina). Metodom sličajnog izbora, pacijenti na terapiji atorvastatinom (20 mg) su dobijali oktakozanol (20 mg)/dan (n = 45) ili placebo/dan (n = 42) tokom 13 nedelja. Serološki markeri oksidativnog stresa i antioksidantne zaštite koji su određivani su: totalni antioksidativni status (TAS), totalni oksidativni status (TOS), produkti uznapredovale oksidacije proteina (AOPP) i paraoksonaza 1 (PON1). Svi parametri su analizirani na početku, nakon 8 i 13 nedelja suplementacije. Oxy-skor je izračunat korišćenjem *protective* skora i *damage* skora, koji su prethodno određeni kao vrednosti z-skora za svakog pacijenta u odnosu na kontrolu.
Vrednost oxi-skora je značajno porasla nakon 13 nedelja. Pacijenti u suplementiranoj grupi imali su viši oxy-skor (geometrijska sredina i interval pouzdanosti od 95% *log*- vrednosti) [0.6825 (0.6093-0.7558) vs 0.4428 (0.3328-0.5528), p <0.001] u poređenju sa bazalnim vrednostima. Pacijenti u placebo grupi takođe su imali viši oxy-skor [0.6989 (0.6408-0.7569) vs 0.4865 (0.3843-0.5888), p <0.001] u poređenju sa bazalnim vrednostima.
Nakon osam sedmica suplementacije nije bilo značajnih promena u vrednostima oxi-skora.
Iako oktakozanol u nekim studijama pokazuje pozitivne efekte na lipidni profil, kombinacija oktakozanola sa atorvastatinom nije dovela do smanjenja vrednosti oxi-skora kod pacijenata na hroničnoj terapiji.

EFFECTS OF OCTACOSANOL SUPPLEMENTATION ON OXIDATIVE STRESS INDEX IN PATIENTS ON ATORVASTATIN TREATMENT

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Octacosanol, a major component of polycosanol, may have positive effects in the treatment of dyslipidemia in both primary and secondary prevention.
Statins are among the most frequently prescribed drugs for hypercholesterolemia. The overall benefits observed with statins are suggesting effects beyond cholesterol lowering, whereby modulation of oxidative stress is an important one.
The aim of the present study was to investigate possible beneficial effects of octacosanol supplementation on oxidative stress index (oxy-score) in patients on chronic atorvastatin therapy.
A randomized, parallel, double-blind, placebo-controlled study included 87 patients (aged 40–80y). They were randomly assigned to receive either atorvastatin 20 mg/d + placebo (*n* = 45) or atorvastatin 20 mg/d + octacosanol 20 mg/d (*n* = 42) for 13 weeks. Serological markers of oxidative stress and antioxidant defense include total antioxidant status (TAS), total oxidant status (TOS), advanced oxidation protein products (AOPP) and paraoxonase 1 (PON1) activity. All parameters were analyzed at baseline, after 8 and 13 weeks of supplementation. The oxy-score was calculated using protective score and damage score, which were determined as z-score values for every subject in a relation to the controls.
Significant increase in calculated oxy-score was found in both group after 13 weeks. Patients in supplemented group had higher oxy-score (geometric mean and 95% confidence interval derived from log-normal values) [0.6825 (0.6093–0.7558) vs 0.4428 (0.3328–0.5528), p < 0.001] compared to baseline value. Patients in placebo group had also higher oxy-score [0.6989 (0.6408–0.7569) vs 0.4865 (0.3843–0.5888), p < 0.001] compared to baseline value. There were not any significant changes in oxy-score at week 8.
Although octacosanol might offer some lipid lowering benefits, combination of octacosanol with atorvastatin was not sufficient to induce a remarkably decrease in oxy-score in patients on chronic therapy.

BKHP1 / FQSP1

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BEZBEDNOST I KVALITET HRANA / FOOD QUALITY AND SAFETY

Sinergistički antioksidativni efekti sastojaka pice

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Pica je tradicionalno italijansko jelo, koje takođe spada među najpopularnije vrste brze hrane u svetu. Najpoznatiji sastojci pice su paradajz i šampinjoni, a od začina origano i bosiljak. Cilj ovog rada je bio da se ispita antioksidativno dejstvo pojedinačnih i kombinovanih ekstrakata sastojaka pice da bi se odredili potencijalni sinergistički efekti u njihovim kombinacijama. Koncentrat paradajza je ekstrahovan pomoću heksana i vrele vode, a dobijeni ekstrakti su rastvoreni u DMSO i pomešani da bi se dobio ekstrakt paradajza (T). Sveži šampinjoni, kao i sveži i suvi origano (FO, DO) i bosiljak (FB, DB) su ekstrahovani korišćenjem 96% etanola i 50% etanola. Nakon toga, kombinovani ekstrakti su pripremljeni mešanjem pojedinačnih ekstrakata na sledeći način: 50%T + 40%FCh + 10% začina (FO/FB/DO/DB) i 50%T + 40%FCh + 5% začina (FB/DB) + 5% začina (FO/DO). Antioksidativno dejstvo ekstrakata je mereno spektofotometrijski korišćenjem DPPH, ABTS, FRAP, β-karoten/linolna kiselina (β-CB) metoda, i određivanjem ukupnog redukcionog potencijala (TRP) na koncentraciji od 1 mg/mL. Interakcije su procenjene korišćenjem indeksa kombinacije (CI), pri čemu je CI>1,1 smatrano sinergističkim efektom. Antioksidativno dejstvo testiranih ekstrakata je variralo u širokom opsegu u svim primenjenim testovima i to: DPPH test (6,77-98,03%), ABTS test (29,98-93,95%), FRAP test (35,28-1401,41 μmol Fe (II)/g), β-CB test (28,45-70,82%) i TRP test (76,74-1717,24 μmol AAE/g). DO i FO, za kojima slede DB i FB, su ispoljili najjače antioksidativno dejstvo u svim testovima, dok su najniže vrednosti dobijene za T i FCh. Nisu pronađene statistički značajne razlike u aktivnosti ekstrakata dobijenim 96% i 50% etanolom. Ekstrakti su pokazali sinergističke efekte u većini kombinacija, sa najvišim vrednostima CI u kombinacijama TFChDO, TFChFBFO i naročito TFChDBDO. Dobijeni rezultati ukazuju da bi upotreba konvencionalnih začina u pici, a posebno DO, značajno mogla da poveća lekovite učinke paradajza i šampinjona.

Synergistic Antioxidant Effects of Pizza Ingredients

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Pizza is a traditional Italian dish and one of the world's most popular fast foods. The most famous pizza ingredients are tomato and champignons and both oregano and basil as spices. The aim of the present study was to examine antioxidant activity of individual and combined extracts of main pizza ingredients in order to investigate possible synergistic effects of their combinations. Tomato concentrate was extracted using hexane and hot water and obtained extracts were dissolved in DMSO and mixed to obtain tomato extract (T). Fresh champignons (FCh) and both fresh and dry oregano (FO, DO) and basil (FB, DB) were extracted using 96% ethanol and 50% ethanol. Subsequently, combined extracts were prepared by mixing the individual extracts as following: 50% of T+40% of FCh+10% of spice (FO/FB/DO/DB) and 50% of T+40% of FCh+5% of spice (FB/DB)+5% of spice (FO/DO). Antioxidant activity of extracts was evaluated spectrophotometrically using DPPH, ABTS, FRAP, β-carotene/linoleic acid (β-CB) and total reducing power (TRP) assays at concentration of 1 mg/mL. The interactions were assessed using combination index (CI), where CI>1.1 was evaluated as synergistic. The antioxidant activity of tested extracts varied in the broad range in all of the applied assays, i.e. DPPH assay (6.77-98.03%), ABTS assay (29.98-93.95%), FRAP assay (35.28-1401.41 μmol Fe (II)/g), β-CB assay (28.45-70.82%) and TRP assay (76.74-1717.24 μmol AAE/g). DO and FO, following by DB and FB, performed the strongest antioxidant activities in all assays, while the lowest values were obtained for T and FCh. Statistically significant differences among extracts obtained using 96% and 50% ethanol were not found. The extracts showed synergistic interactions in most of their combinations, with the highest CI values for combinations TFChDO, TFChFBFO and especially for TFChDBDO. The obtained results suggest that the usage of conventional spices in pizza, especially of DO, could significantly boost the health effects of tomato and champignons.

BKHP2 / FQSP2

Antioksidativni kapacitet ekstrakata zelenog i crnog čaja – hemometrijski iskoraci u selekciji antioksidativnih testova i multipotentnih herbalnih ekstrakata

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Antioksidativni kapacitet etanolnih ekstrakata crnih i zelenih čajeva (37 uzoraka) je određen primenom devet analitičkih metoda od toga: pet spektrofotometrijskih – TPC (Folin–Ciocalteu sadržaj ukupnih fenola), redukcijom DPPH (2,2-difenil-1-pikrilhidrazil) i ABTS (2,2′-azinobis-(3-etilbenzotiazoline-6-sulfonat)) radikala, merenjem Fe(III) i Cu(II) antioksidativnog redukujućeg kapaciteta (FRAP i CUPRAC); jedne tankoslojno-hromatografske metode kuplovane sa DPPH derivatizacijom (TLC-DPPH) i tri elektrohemijske metode – ciklična voltametrija (CV), diferencijalna pulsna voltametrija (DPV) i voltametrija sa kvadratnim impulsima potencijala (SWV). Metode su rangirane primenom sume razlike rangova (SRD). Kao najpogodniji eseji su odabrani FRAP, CUPRAC i ABTS, za kojima ubrzo slede DPPH, CV i TPC. Nešto lošije performanse pokazuju SWV i DPV, dok se vrednosti dobijene pomoću TLC-DPPH ne razlikuju od slučajnog statističkog efekta. Informacije dobijene pomoću svih devet eseja su dalje objedinjene kako bi se odabrali antioksidativno polipotentni uzorci.

Antioxidant capacity of green and black tea extracts – Chemometric advancements in selection of antioxidant activity assays and multipotent herbal extracts

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The antioxidative capacity of ethanolic extracts of 37 black and green tea samples were measured using nine antioxidative capacity assays: five spectrophotometric – TPC (total phenolic content by Folin–Ciocalteu), DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS (2,2′-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid), FRAP (ferric reducing antioxidant power), and CUPRAC (cupric ion reducing antioxidant capacity); one based on thin-layer chromatography coupled with DPPH derivatization (TLC-DPPH), and three electrochemical methods - cyclic voltammetry (CV), differential pulse voltammetry (DPV), and square wave voltammetry (SWV). The methods were compared by a novel consensus driven sum of ranking differences (SRD) approach. FRAP, CUPRAC, and ABTS found to be the most suitable approaches, closely followed by DPPH, CV and TPC. SWV and DPV had lower performance, while TLC-DPPH assay could not be distinguished from a statistically random effect. The information from all nine assays was further fused in order to rank and select the extracts that exhibit the most of their antioxidant power across all tested methods, i.e. the antioxidative polypotent ones.

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BKHP3 /FQSP3

Fenolni profil, antioksidativna i antimikrobna aktivnost srpskog čaja od lipe

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Glavni cilj ove studije je ispitivanje fenolnog profila čaja od lipe poreklom iz Srbije (sakupljenih iz prirode i komercijalno nabavljenih). Fenolni profil ispitan je korišćenjem jednostavne, brze, visokopropusne visokoefikasne tankoslojne hromatografije (*HPTLC*). Takođe, ispitivana je i antioksidativna aktivnost korišćenjem DPPH-HPTLC u cilju identifikovanja jedinjenja sa potencijalnom antioksidativnom aktivnošću, kao i doprinos pojedinačnih jedinjenja ukupnoj antioksidativnoj aktivnosti. Difuziona metoda bunarića je korišćena u cilju određivanja antimikrobne aktivnosti ekstrakta čaja lipe prema 23 različita humana i biljna patogena. Na osnovnu dobijenih HPTLC hromatograma može se uočiti sličan fenolni profil, sa malim razlikama između *Tilia* x *europaea* L., *Tilia platyphyllos* Scop. i *Tilia cordata* Mill. na osnovu samog profila i intenziteta zona. U ovoj studiji identifikovali smo osam fenolnih komponenata. Nakon potapanja u rastvor DPPH uočene su žute zone na ljubičastoj pozadini u hR_F opsegu između 50 i 90. Zone sa potencijalnom antioksidativnom aktivnošću su identifikovane kao rutin, hlorogena kiselina, izokvercitrin, hiperozid, astragalin, kvercitrin, tilirozid i kofeinska kiselina. Kofeinska kiselina i dve nepoznate polarne komponente sa hR_F vrednostima između 2 i 5 najviše su doprinele antioksidativnoj aktivnosti. Jača antimikrobna aktivnost je primećena prema Gram-pozitivnim bakterijama u poređenju sa Gram-negativnim bakterijama i kvascima. Takođe, nije zabeležena ni značajna razlika u aktivnosti između prikupljenih i komercijalnih uzoraka. Najosetljiviji izolati bili su *Streptococcus mutans, S. pyogenes, Enterococcus faecalis*, a posebno *Staphylococcus aureus* i *Bacillus subtilis* sa izraženim zonama inhibicije. Ova studija predstavlja dobru polaznu tačku za dalje istraživanje farmakoloških osobina čaja od lipe na ovim prostorima.

Phenolic profile, antioxidative, and antimicrobial activity of Serbian linden tea

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The main aim of the current study was an investigation of phenolic profile of Serbian linden tea (collected and commercial). Phenolic profile of Serbian linden tea was investigated using simple, fast, high throughput high-performance thin-layer chromatography (HPTLC) method. Antioxidative activity was investigated using DPPH-HPTLC in order to identify compounds with potential antioxidative activity as well as contribution of individual compounds to total antioxidative activity. The well diffusion method was used to determine the antimicrobial activity of linden tea extracts against 23 different human and plant pathogens. Based on visual inspection of HPTLC chromatograms, there is similar phenolic pattern with small differences between *Tilia* x *europaea* L., *Tilia platyphyllos* Scop., and *Tilia cordata* Mill., with regard to zone intensities and the pattern itself. In present study, we identified eight phenolic compounds. Separated compounds showed yellow bands against purple background in hR_F range between 50 and 90 after dipping in DPPH solution. Those compounds were identified as rutin, chlorogenic acid, isoquercetin, hyperoside, astragalin, quercitrin, tiliroside, and caffeic acid. Caffeic acid and two unknown polar compounds with hR_F values at 2 and 5 showed highest contribution to antioxidative activity. Generally, higher antimicrobial activity was observed against Gram-positive bacteria compared to Gram-negative bacteria and yeasts. No significant difference has been noticed in the activity between collected and commercial samples. The most sensitive strains were *Streptococcus mutans*, *S. pyogenes*, *Enterococcus faecalis*, and especially *Staphylococcus aureus* and *Bacillus subtilis* with highlighted inhibition zones. This study represents a good starting point for further exploration of pharmacological properties of linden tea within this region.

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BKHP4 / FQSP4

Četvorogodišne odležavanje poboljšava fenolni sastav crvenih vina iz Vojvodine

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Crvena vina predstavljaju bogat izvor fenolnih jedninjenja, koja dospevaju u vino iz grožđa. Fenolna jedinjenja doprinose organoleptičkim svojstvima, ali mogu da ispolje i blagotvorna dejstva na ljudski organizam (antioksidativno, antiinflamatorno, kardioprotektivno itd.). Tokom odležavanja odvijaju se hemijske reakcije koje dovode do promena u fenolnom sastavu vina. Većina vina konzumira se nakon izvesnog vremena odležavanja. Cilj ovog rada je ispitivanje uticaja vremena odležavanja na sadržaj fenolnih jedinjenja (galna, p-kumarinska i siringinska kiselina, katehin, resveratrol) u crvenim vinima proizvedenim od sorti grožđa uzgajanih u Vojvodini. Uzorci vina pripremljeni su od tri sorte grožđa (Probus, Frankovka, Rumenika) uzgajanih u eksperimentalnim vinogradima Poljoprivrednog fakulteta i vinogradima Mrđanin. Nakon četiri godine odležavanja, u staklenim bocama, kvantifikovana su fenolna jedinjenja visoko-efikasnom tečnom hromatografijom sa spektrofotometrijskom detekcijom. Fenolna jedinjenja prisutna su u koncentracijama: galna kiselina 14.99-49.55 mg/L, p-kumarinska kiselina 3.81-5.61 mg/L, siringinska kiselina 5.82-12.18 mg/L, katehin 13.71-37.21 mg/L i resveratrol 0.57-3.62 mg/L. Njihova koncentracija varira u zavisnosti od sorte grožđa. Vino od sorte Rumenika ima najveću količinu galne kiseline i resveratrola. Siringinska kiselina prisutna je najveše u vinima dodijenim od sorte Frankovka, a p-kumarinska kiselina u vinima od sorte Probus. Poređenje sa rezultatima za mlada vina iste sorte, porekla i godine berbe pokazuje da je sadržaj galne, siringinske i p-kumarinske kiseline porastao nakon četvorogodišnjeg odležavanja. Istovremeno, sadržaj resveratrola se smanjio, a trend sadržaja katehina zavisan je od sorte grožđa. Prikazani rezultati neophodni su za adekvatnu selekciju lokalnih sorti u cilju dobijanja proizvoda sa većim sadržajem blagotvornih fenolnih komponenata.

Four years of aging improves phenolic composition of red wines from Vojvodina

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Red wines are a rich source of phenolic compounds which are transferred from grapes. Phenolic compounds contribute to organoleptic properties of wine but also can exhibit beneficial effects on human health (antioxidative, anti-inflammatory, cardioprotective etc.). During wine aging chemical reactions occur which lead to changes of phenolic composition. Since most of the wines are consumed after certain aging, the aim of this work was to determine the content of selected phenolic compounds (gallic, p-coumaric, syringic acid, catechin, resveratrol) in four year aged red wines made from local grape varieties grown in Vojvodina. Red wine samples were made from three different grape varieties (Probus, Frankovka, Rumenika) grown in experimental vineyards of Faculty of Agriculture and vineyards Mrdjanin. After four years of aging, in glass bottle, phenolic compounds were quantified using HPLC with UV detection. Levels of phenolic compounds in aged red wines were as follows: gallic acid 14.99-49.55 mg/L, p-coumaric acid 3.81-5.61 mg/L, syringic acid 5.82-12.18 mg/L, catechin 13.71-37.21 mg/L and resveratrol 0.57-3.62 mg/L. Concentration of phenolic compounds differed among analyzed samples. Wine from Rumenika variety had the highest levels of gallic acid, catechin and resveratrol. Syringic acid and p-coumaric acid were most abundant in wines from Frankovka and Probus, respectively. In comparison with young wines from the same vintage, vineyards and variety showed that gallic, p-coumaric and syringic acid levels increased during ageing, resveratrol decreased, while for catechin this trend depended on the grape variety. These data are necessary in selection of local varieties for production of wines with higher content of beneficial phenolic components.

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BKHP5 / FQSP5

Fluorescentna spektroskopija i multivarijaciona analiza za procenu stabilnosti brašna od različitih žitarica tokom stajanja i termalne obrade

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U ovom radu korišćena je Fluorescentna spektroskopija u kombinaciji sa algoritmom Multivarijaciono Razlaganje Krivih (MCR-ALS) za procenu stabilnosti brašna od različitih žitarica, bazirana na stabilnosti pojedinačnih fluorescentnih komponenti uzorka, koje se mogu izmeniti tokom vremena ili zagrevanjem. Testirani su uzorci komercijalnog kukuruznog brašna (Kukuruzno brašno za ljudsku ishranu), pšenično (T-500) i graham brašno, nabavljeni direktno sa lokalnog tržišta. Fluorescentni emisioni spektri uzoraka brašna su mereni u opsegu od 280 nm do 660 nm, nakon pobuđivanja od 250 nm do 360 nm, sa korakom od 10 nm. Kao rezultat analize, četiri fluorescentne komponente su dobijene iz emisionih spektara svakog analiziranog uzorka. Naši rezultati pokazaju da su položaji komponenti nepromenjeni kod svih vrsta brašna nakon dva mesesa skladištenja, dok su za uzorke sa termalnom obradom na 180° C u trajanju od 1h pomereni. Ova metoda može biti korisna i jednostavna za skirning velikog broja uzoraka brašna.

Fluorescence spectroscopy and Multivariate Analysis for the assessment of stability of the cereal flours during storage and thermal processing

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In this work, we used Fluorescence spectroscopy in combination with the Multivariate Curve Resolution-Alternating Least Squares (MCR-ALS) algorithm for the assessment of stability of the cereal flours, based on stability of their individual fluorescence components, which can be altered by shelf life or heating. The tested samples were commercial maize flour (Maize flour for human consumption),wheat (T-500) and graham flour, purchased directly from a local market. The fluorescence emission spectra of the flour samples were measured in the range of 280 nm to 660 nm with excitation wavelength varing from 250 nm to 360 nm in 10-nm steps. Resulting from the analysis, the four flourescence components were derived from the emission spectra of every analyzed sample. Our results showed that the components' positions were unchanged for all flours after 2 months storage, whereas for the samples with thermal processing at 180 °C during 1 h, the positions were shifted. This method may be useful and simple for screening of a large number of flour samples.

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BKHP6 / FQSP6

Primjena omjera stabilnih izotopa ugljika ($^{13}C/^{12}C$) u ocjeni autentičnosti bagremovog meda (*Robinia pseudoacacia* L.)

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Bagremov med (*Robinia pseudoacacia* L.) jedna je od najcjenjenijih vrsta meda na tržištu; značajne količine proizvode se u mnogim europskim zemljama, a najveće se količine proizvedu u istočnoj Europi i Kini. Karakterizira ga vrlo svijetla boja, vrlo blagi miris i aroma (cvjetno –voćna, topla), a u okusu dominira slatkoća. U Hrvatskoj je bagremov med najzastupljenija vrlo cijenjena vrsta, a proizvodi se najviše u kontinentalnom dijelu.

Zbog relativno visoke cijene, ograničene i zahtjevne proizvodnje med je česta meta krivotvorenja, a metode su različite, od netočnog deklariranja botaničkog i geografskog podrijetla, do zamjene dijela ili cijelog sadržaja sa šećernim sirupima. Različiti načini krivotvorenja zahtijevaju i različitu metodologiju otkrivanja.

Metoda određivanja omjera stabilnih izotopa ugljika ($^{13}C/^{12}C$) već se tridesetak godina koristi za dokazivanje krivotvorenja dodatkom šećernih sirupa uglavnom podrijetlom iz kukuruza ili šećerne trske. Zadnjih nekoliko godina istraživanja su orijentirana na mogućnost primjene ove metode za dokazivanje botaničkog i geografskog podrijetla meda.

U ovom radu prikazani su rezultati određivanja omjera stabilnih izotopa ugljika ($^{13}C/^{12}C$) u bagremovom medu s područja Republike Hrvatske i analizirana je mogućnost primjene ove metode u dokazivanju različitih aspekata autentičnosti meda.

Application of Stable Carbon Isotope Ratio ($^{13}C/^{12}C$) in the assessment of black locust (*Robinia pseudoacacia* L.) honey authenticity

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Black locust (*Robinia pseudoacacia* L.) honey is one of the most appreciated species on the market; significant amounts are produced in many European countries, with largest production in Eastern Europe and China. It is characterized with very bright colour, weak odour and aroma (floral-fruity and warm) while sweetness is dominant in taste. In Croatia black locust honey is mostly produced in the continental region and it is considered to be the most abundant and appreciated type.

Honey is often a target of adulteration due to its relatively high prices, limited and demanding production. It can be adulterated in many different ways and some of them are mislabelling of botanical and geographical origin or partial or total replacement with sugar syrups. Consequently, different ways of adulteration require different detection methodologies.

In the last thirty years stable carbon isotope ratio ($^{13}C/^{12}C$) method is used for detection of honey adulteration with sugar cane or corn syrups. Recently, researches have been focused on application of this method for honey botanical and geographical origin assessment.

This paper presents the results of stable carbon isotope ratio ($^{13}C/^{12}C$) in black locust honey from the Republic of Croatia and consideres the possibility of using this method in assessment of different aspects of honey authenticity.

BKHP7 / FQSP7

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Antimicrobial and toxic properties of essential oils of *Boswellia serrata* Roxb. and *Mentha piperita* Linn.

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Incense (*Boswellia serrata* Roxb) and mint (*Mentha piperita* L.) are recognised as valuable herbs in traditional therapy for diarrhoea, dysentery and fevers. Antimicrobial potential through double-dilution assay of two commercial essential oils (EOs) of incense and mint against bacterial and yeast isolates was the aim of the present study. Obtained MIC and MBC values point out activity of mint essential oil (EO) against multiresistant *P. aeruginosa* and *C. albicans* isolate (MIC/MBC at 6.25 and 12.5 µl/ml, respectively). Toxicity of incense EO reached LC_{50} value at 3.07 µl/ml, while mint EO showed higher toxicity at 0.40 µl/ml. The most represented components of mint EO were L-menthone (20.86%) and menthol (31.86%) while β-thujene (29.77%) dominated in Incense so they could be proposed for further investigation. The Impact of the study is examination of natural sources of antimicrobial agents in food additives like spices, for treatment of multiple resistant bacterial and yeast strains.

Antimikrobna i toksična svojstva esencijalnih ulja Bosvellia serrata Rokb. i Mentha piperita Linn.

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Tamjan (Bosvellia serrata Rokb) i menta (Mentha piperita L.) su prepoznate kao značajne biljke u tradicionalnoj terapiji za dijareju, dizenteriju i groznicu. Antimikrobni potencijal kroz test duplog razređenja na dva komercijalna eterska ulja (EO) tamjana i mente protiv bakterijskih i izolata kvasaca je bio cilj ovog rada. Dobijene MIC i MBC ukazuju na aktivnost ulja mente prema multirezistentnim *P. aeruginosa* and *C. albicans* izolatima (MIC/MBC u 6.25 i 12.5 µl/ml). Toksičnost tamjanovo EO je dostiglo vrednost LC50 na 3.07 ml/ml, dok je mentino EO pokazalo veću toksičnost pri 0.40 µl/ml. Najzastupljenije komponente EO mente su L-menton (20.86%) i mentol (31.86%), dok je β-tujen (29.77%) dominirao u tamjanu, tako da se mogu predložiti za dalje istraživanje. Značaj studije je ispitivanje alternativnih izvora antimikrobnih sredstava u aditivima hrane, začinima za lečenje višestruko otpornih bakterijskih I gljivičnih sojeva.

Mikrobiološki kvalitet namirnica u republici srpskoj u 2016. godini

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Mikrobiološki kvalitet namirnica predstavlja izuzetno značajan parametar zdravstvene ispravnosti i kvaliteta namirnica. Mikrobiološka kontaminacija hrane može da bude uzrok veoma ozbiljnih zdravstvenih komplikacija koje nastaju kao posljedica bolesti izazvanih unosom kontaminirane hrane. Pravilnikom o mikrobiološkim kriterijumima za hranu utvrđeni su mikrobiološki kriterijumi za određene mikroorganizme u hrani koji moraju da budu zadovoljeni u cilju proizvodnje i distribucije zdravstveno ispravne hrane krajnjem potrošaču. Cilj rada je dati pregled mikrobiološkog kvaliteta hrane koja je ispitana u 2016. godini u Republici Srpskoj.
Podaci o mikrobiološkoj ispravnosti hrane su preuzeti iz godišnjeg izvještaja o zdravstvenom stanju stanovništva Republike Srpske koji izrađuje Institut za javno zdravstvo Republike Srpske.
U 2016. godini na mikrobiološku ispravnost ispitano je 16507 uzoraka namirnica, pri čemu je 13,2% uzoraka je pregledano prilikom uvoza, 14,1% iz prometa i 72,6% iz proizvodnje. Od toga 101 uzorak je bio mikrobiološki neispravan (0,61%). Najviše neispravnih uzoraka je bilo iz kategorije uzoraka hljeba, tjestenina i keksa (38 uzoraka; 37,6%), zatim sladoleda (23,8 %), mesa i proizvoda od mesa (11,9%), žitarica, leguminoza i brašna (10,9%), dok ostalo (15,8%) čine uzorci iz kategorije mlijeka i mliječnih proizvoda, proizvoda od ribe, kolači, voće, povrće i njihovi proizvodi, kafa, kakao i čajevi, bezalkoholna pića, te gotova jela. Među uzorcima dječije hrane i dijetetskih namirnica (205) nije pronađena mikrobiološka neispravnost. Što se tiče rezultata pregleda uzoraka na pojedine mikroorganizme, u najviše neispravnih uzoraka su izolovane *Enterobacteriaceae* sp. (45), zatim kvasac i plijesni (30), *Salmonella* sp. (11), *Lysteria monocytogenes* (4), dok je 11 uzoraka bilo neispravno na ukupan broj bakterija, te ostalo 1 uzorak.
S obzirom na pronađenu zdravstvenu neispravnost namirnica sa aspekta mikrobioloških kriterijuma, potrebno je nastaviti i pojačati kontinuiranu kontrolu zdravstvene ispravnosti namirnica u Republici Srpskoj, naročito dječije hrane koja je namijenjena osjetljivoj populaciji dojenčadi i male djece i drugim vulnerabilnim kategorijama stanovništva.

Microbiological food quality in the Republic of Srpska in 2016

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The microbiological food quality is an extremely important parameter for foodstuffs. Microbiological food contamination can be the cause of very serious health complications caused by the ingestion of contaminated food. The Ordinance on microbiological criteria for food has established microbiological criteria for certain microorganisms in food that must be met in order to produce and distribute safe food to the consumer. The aim of this paper is to give an overview of the microbiological quality of food that was tested in 2016 in the Republic of Srpska.
The data on microbiological food safety are taken from the annual report on the health condition of the population of the Republic of Srpska, prepared by the Public Health Institute of the Republic of Srpska.
In 2016, 16507 samples of food were tested for microbiological correctness (13.2% from import, 14.1% from the market and 72.6% from production). Out of that, 101 samples were microbiologically defective (0.61%). The most unsafe samples were from the category of bread, pasta and biscuits (37.6%), followed by ice-creams (23.8%), meat and meat products (11.9%), cereals, legumes and flour (10.9%), while the rest of the samples (15.8%) were from the category of milk and dairy products, fish products, cookies, fruits, vegetables and their products, coffee, cocoa and teas, soft drinks and ready-made dishes. Samples of food intended for infants and small children (205) are shown to be microbiologically safe. As for the results of the examination of the samples on individual microorganisms, *Enterobacteriaceae* sp. were detected in 45 samples, then yeast and mold in 30, *Salmonella* sp. in 11, *Lysteria monocytogenes* in 4, while 11 samples were incorrect for the total number of bacteria, and 1 sample the other.
It is necessary to continue and strengthen the continuous control of the food safety in the Republic of Srpska, especially food intended for the sensitive population of infants and young children and other vulnerable population.

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BKHP9 / FQSP9

Bakterije mlečne kiseline u mlevenom mesu svinja kontaminiranom *Salmonella* spp sa dodatkom etarskog ulja origana pakovanom u vakuum i modifikovanu atmosferu

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Tokom 15 dana praćen je broj bakterija mlečne kiseline u mlevenom mesu svinja eksperimentalno kontamiranog *Salmonella* spp (10^6 CFU/g) u koje su dodate različite koncentracije (0%, 0,3%, 0,6% i 0,9%) etarskog ulja origana (EUO) čija je glavna supstanca bila karvakrol (77.6%). Uzorci mlevenog mesa su pakovani u vakuum (V) ili modifikovanu atmosferu (MAP-30%O_2/50%CO_2/20%N_2) i skladišteni na temperaturi 3 ± 1 °C. Uzorci su analizirani na početku eksperimenta, trećeg, šestog, devetog, dvanaestog i petnaestog dana skladištenja. Na početku eksperimenta dodatak etarskog ulja origana smanjio je broj bakterija mlečne kiseline, a broj ovih bakterija kretao se od 4,20 (MAP+0,9% EUO) do 4,45 (V) log CFU/g. Tokom skladištenja broj bakterija mlečne kiseline povećao se za 2,69, 2,50, 1,77, 1,72, 2,81, 2,38, 1,98 i 1,69 log CFU/g u uzorcima mlevenog mesa pakovanog u MAP, MAP+0,3%, MAP+0,6%, MAP+0,9%, V, V+0,3%, V+0,6%, V+0,9%. Rast ovih bakterija bio je najizraženiji u uzorcima bez dodatka EUO i na kraju eksperimenta dostigao je broj od 7.13 log CFU/g u uzorcima pakovnim u modifikovanu atmosferu i 7.26 log CFU/g u uzorcima pakovanim u vakuum. Najizraženiji antibakteriski efekat postignut je dodatkom 0,9% etarskog ulja origana i broj bakterija mlečne kiseline petnaestog dana skladištenja u uzorcima pakovanim u modifikovanu atmosferu sa dodatkom 0,9% EUO bio je 5,92 log CFU/g, a u uzorcima pakovanim u vakuum sa dodatkom 0,9% EUO bio je 5,93 log CFU/g. pH vrednost na početku eksperimenta kretala se od 5,96 do 6,01. Pad pH vrednosti u uzorcima bio je u korelaciji sa porastom bakterija mlečne kiseline i na kraju skladištenja bila je između 5.81 i 5.90. Rezultati ovog ogleda pokazuju da je antibakterijski efekat EUO dozno zavisan i najizraženiji tokom prva tri dana skladištenja, dok je najveći porast bakterija mlečne kiseline bio zabeležen između šestog i devetog dana skladištenja.

LAB in minced pork contaminated with *Salmonella* spp treated with oregano essential oil packaged in vacuum and MAP

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The survival of lactic acid bacteria (LAB) during 15 days was evaluated in minced pork experimentally contaminated with *Salmonella* spp. (10^6 CFU/g) which was treated with different concentrations (0%, 0.3%, 0.6% and 0.9%) of the oregano essential oil (OEO) predominately composed of carvacrol (77.6%), packaged under vacuum or MAP (30%O_2/50%CO_2/20% N_2) and stored at 3 ± 1 °C. Mince was analyzed on day 0 and on days 3, 6, 9, 12 and 15 of storage. At the beginning of the experiment the addition of OEO immediately reduced the number of LAB and their counts ranged between 4.20 (MAP+0.9% OEO) and 4.45 (V) log CFU/g. During the storage period, LAB counts in pork increased by 2.69, 2.50, 1.77, 1.72, 2.81, 2.38, 1.98 and 1.69 log CFU/g in MAP, MAP+0.3%, MAP+0.6%, MAP+0.9%, V, V+0.3%, V+0.6%, V+0.9% samples, respectively. The increase was the most pronounced in the samples without essential oil added and at the end of the study LAB number reached 7.13 log CFU/g in MAP samples and 7.26 log CFU/g in vacuum packaged samples. The most pronounced antibacterial effect was achieved by the combination of MAP and 0.9% OEO where LAB number was 5.92 log CFU/g at the day 15 and vacuum and 0.9% OEO where LAB counts reached 5.93 log CFU/g. pH of the samples at the beginning of the experiment raged between 5.96 and 6.01. Decrease of pH in the samples correlated with increase of LAB counts in the samples and at the end of the storage period was 5.81 and 5.90. Results from the present study indicate that OEO exhibited dose-dependent effect that was stronger during first three days of storage, while the greatest increase of these bacteria was noticed on the day 6 and 9 of storage.

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BKHP10 / FQSP10

Određivanje sadržaja arsena u vodama izvorišta i vodovodne mreže na teritoriji opštine Pančevo

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Povećanjem ljudske aktivnosti značajno su se promenili globalni ciklusi metala i metaloida, uključujući toksične neesencijalne elemente kao što su As, Hg, Cd i Pb. Arsen pokazuje kompleksan metabolizam. I neorganski i organski oblik arsena mogu prouzrokovati toksične efekte na organizam, koji u zavisnosti od dužine ekspozicije mogu biti akutni ili hronični. Hronični toksični efekti arsena se mogu javiti kao rezultat profesionalne izloženosti ili usled prisustva visokih koncentracija arsena u hrani i vodi.
U okviru studije, u periodu od 2015. do 2017. godine, urađena je analiza arsena u 342 uzorka vode za piće sa teritorije Grada Pančevo, hidridnom tehnikom atomsko apsorpcione spektrometrije. Analizirani su uzorci izvorišnih bunara kao i uzorci vode iz distributivnih mreža JKP „Vodovod i kanalizacija" Pančevo, JKP „Glogonj", JKP „Jabuka" i JKP „Banatsko Novo Selo". U okviru JKP „Vodovod i kanalizacija" Pančevo, bunari izvorišta „Gradska Šuma" sadrže arsen u koncentraciji većoj od maksimalno dozvoljene koncentracije od 0,01 mg/L i kretale su se do 0,04 mg/L. Bunari izvorišta "Sibnica" i "Filter" nisu opterećeni značajnom koncentracijom arsena. Voda koja se distribuira do potrošača u gradu Pančevu kao i u naseljenim mestima Jabuka i Banatsko Novo Selo je hemijski ispravna i zdravstveno bezbedna po pitanju sadržaja arsena. Voda koja se od strane JKP "Glogonj" distribuirala do potrošača u navedenom periodu nije bila hemijski ispravna i zdravstveno bezbedna po pitanju sadržaja arsena, obzirom da su sve izmerene koncentracije bile preko maksimalno dozvoljene vrednosti. Dugogodišnjim praćenjem kvaliteta vode za piće JKP „Glogonj" potvrđena je njena hemijska ne ispravost što je iniciralo da se preduzmu sve neophodne aktivnosti za realizaciju projekta pri ključenja naseljenih mesta Jabuka i Glogonj na gradsku vodovodnu mrežu početkom 2018. godine. Prezentovani podaci pokazuju da je neophodna redovna kontrola uzoraka u vodama izvorišta i vodovodne mreže na sadržaj arsena, obzirom da su bunari izvorišta „Gradska šuma" opterećeni značajnim koncentracijama arsena.

Determination of arsenic content in water sources and water supply network in the municipality of Pancevo

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Increasing human activity significantly changed global cycles of metals and metalloids, including toxic non-essential elements such as As, Hg, Cd and Pb. Arsenic shows complex metabolism. Both, the inorganic and organic forms of arsenic can cause toxic effects on the organism that, depending on the length of the exposure, can be acute or chronic. Chronic toxic effects of arsenic can occur as a result of occupational exposure or due to high concentrations of arsenic in nutrition and water.
Within the study, in the period from 2015 to 2017, the analysis of arsenic in 342 samples of drinking water from the territory of the City of Pancevo was done, with hydride technique atomic apsorption spectrometry. Samples of wells as well as water samples from the distribution networks of JKP "Vodovod i kanalizacija" Pancevo, JKP "Glogonj", JKP "Jabuka" and JKP "Banatsko Novo Selo" were analyzed. Within the JKP "Vodovod i kanalizacija" Pančevo, the wells of the "GradskaŠuma" contain an arsenic at a concentration higher than the maximum permissible concentration of 0,01 mg/L, and ranging up to 0.040 mg / L. The wells of „Sibnica" and„Filter" sources do not contain a significant concentration of arsenic. Water distributed to consumers in the city of Pančevo as well as in the populated places of Jabuka and Banatsko Novo Selo is chemically correct and health safe in terms of arsenic content. The water distributed by the JKP "Glogonj" to the consumers, during the mentioned period, was not chemically correct and health safe in terms of arsenic content, since all the measured concentrations were above the maximum permissible concentration. The long-term monitoring of the quality of drinking water of JKP "Glogonj" confirmed its chemical malfunctioning, which prompted to undertake all necessary activities for realization of the project of connecting the populated places of Jabuka and Glogonj to the city water supply network in the beginning of 2018. The presented data show that regular control of samples in the waters of the wells and the water supply network is necessary for the content of the arsenic, since the wells of the "Gradska Šuma" wells contains a significant concentrations of arsenic.

Antimikrobna aktivnost biotehnološki modifikovanih proteina surutke

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Cilj ovog rada bio ispitivanje antimikrobnog potencijala hidrolizata u prahu proizvedenih enzimskom i mikrobiološkom hidrolizom proteina surutke, koje su praćene postupkom sprej-sušenja, kako bi se ustanovilo koji od ovih procesa omogućava proizvodnju hidrolizata proteina surutke visoke antimikrobne aktivnosti. Enzimska hidroliza je izvršena komercijalnim enzimom tripsinom, dok je fermentacija izvedena primenom soja *Lactobacillus rhamnosus* ATCC 7469. Kvantitativni test antimikrobne aktivnosti dobijenih hidrolizata izveden je testiranjem na tri (G +) bakterije *Staphylococcus aureus* (ATCC 25923), *Bacillus cereus* (ATCC 11778), *Listeria monocytogenes* i (G-) bakteriju *Escherichia coli* (ATCC 25922).
Izvedeni testovi su pokazali da koncentracija 50.0 mg mL^{-1} sprej-sušenog hidrolizata proteina surutke proizvedenog digestijom pomoću tripsina (WPH) suzbija mikrobiološku kontaminaciju uzrokovanu sojevima *S. aureus* ATCC25923, *B. cereus* i *L. monocytogenes*. WPH je sposoban da inhibira rast sojeva *B. cereus* i *L. monocytogenes* za 1,0 log jedinicu i *S. aureus* za 0,94 log jedinice, dok inhibicija rasta Gram-negativne *E. coli* nije primećena. S druge strane, hidrolizat u prahu dobijen fermentacijom surutke (FWH) u istoj koncentraciji ima izraženiju antimikrobnu aktivnost na sve testirane patogene sojeve. Inhibicija rasta je iznosila 2.73 log (CFU mL^{-1}) za *S. aureus*, 3.73 log (CFU mL^{-1}) za *B. cereus*, 4.34 log (CFU mL^{-1}) za *E. coli* i 1.1 log (CFU mL^{-1}) za *L. monocytogenes*. Dobijeni rezultati su pokazali da FWH ispoljava značajno ($p < 0,05$) veću inhibicija rasta sojeva *S. aureus*, *B. cereus* i *E. coli* u poređenju sa WPH.
Na osnovu prikazanih rezultata, fermentacija surutke se može smatrati optimalanim procesom koji omogućava proizvodnju hidrolizata proteina surutke sa izraženom antimikrobnom aktivnošću, koji kao takav može predstavljati kvalitetan prirodni prehrambeni dodatak.

Antimicrobial activity of biotechnologically modified whey proteins

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The aim of this paper was to examine the antimicrobial potential of hydrolysate powders produced by enzymatic and microbial hydrolysis of whey proteins, followed by spray drying, in order to reveal which one of these processes allow the production of whey protein hydrolysate powder with high antimicrobial activity. The enzymatic hydrolysis was carried out by commercial enzyme trypsin, while fermentation was conducted using *Lactobacillus rhamnosus* ATCC 7469 strain. Quantitative tests of the antimicrobial activity of the obtained hydrolysates were performed against three (G^+) bacteria *Staphylococcus aureus* (ATCC 25923), *Bacillus cereus* (ATCC 11778), *Listeria monocytogenes,* and (G^-) bacteria *Escherichia coli* (ATCC 25922).
The performed tests revealed that concentration of 50.0 mg mL^{-1} of spry-dried whey protein hydrolysate produced by tryptic digestion (WPH) suppresses microbial contamination caused by *S. aureus*, *B. cereus* and *L. monocytogenes* strains. The WPH is capable to inhibit growth of *B. cereus* and *L. monocytogenes* for 1.0 log units and *S. aureus* for 0.94 log units, while the growth inhibition of Gram-negative *E. coli* was not observed. On the other hand, hydrolysate powder obtained by whey fermentation (FWH) at same concentration exerts more pronounced antimicrobial activity against all tested pathogenic strains. The growth inhibition was 2.73 log (CFU mL^{-1}) for *S. aureus*, 3.73 log (CFU mL^{-1}) for *B. cereus*, 4.34 log (CFU mL^{-1}) for *E. coli*, and 1.1 log (CFU mL^{-1}) for *L. monocytogenes*. Observed results revealed that FWH has shown significantly ($p<0.05$) higher growth inhibition of *S. aureus*, *B. cereus*, *E. coli* compared to the WPH.
Based on the presented results, whey fermentation could be highlighted as an optimal process that provides the production of whey hydrolysate with the pronounced antimicrobial activity that could be considered as very promising natural food supplement.

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BKHP12 / FQSP12

Vino od borovnice – dobar prirodni izvor fenolnih kiselina

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Poznato je da borovnica (*Vaccinium myrtilus*) obiluje različitim jedinjenjima sa pozitivnim efektima na zdravlje ljudi. Može se konzumirati sirova ili kao prerađena, uključujući vino.Ispitivani uzorci vina proizvedeni su postupkom mikrovinifikacije. Kontrolisano vrenje sprovedeno je uz pomoć kvasaca. U pojedine uzorke, pre fermentacije, pridodati su enzim i šećer, kako bi se povećao sadržaj polifenolnih jedinjenja u krajnjem proizvodu. Dok je sadržaj ukupnih fenola (SUP) određen spektrofotometrijski Folin Ciocalteu-ovom metodom, pojedinačni polifenoli kvantifikovani su pomoću UPLC TQ-MS/MS. Konačno, procenjen je i redukcioni potencijal (metoda FRAP), kao i anti-DPPH radikalska aktivnost.
Primenjeni postupak mikrovinifikacije značajno je uticao kako na polifenolni profil, tako i na antioksidativni potencijal ispitivanih uzoraka. Naime, vino obogaćeno polifenolima, kao i povecanim antioksidativnim kapacitetom, dobijeno je dodatkom enzima i šećera pre početka fermentacije. Suprotan trend, međutim, uočen je za kontrolni uzorak, proizveden bez dodatka enzima i šećera. Među kvantifikovanim polifenolima, posebno se ističu derivati hidroksibenzoeve kiseline, konkretno, vanilinska, protokatehuinska i *p*-hidroksibenzoeva kiselina. Vrednosti SUP bile u opsegu 2135,77-2357,23 mg GAE/L, a vrednosti redukcionog potencijala (FRAP) 63,27-76,32 mmol/L Fe^{2+}. S druge strane, anti-DPPH radikalska aktivnost (predstavljena kao vrednost IC_{50}) iznosila je 1,37-1,64%. Sveobuhvatno posmatrano, može se reći da vino od borovnice predstavlja bogat prirodni izvor derivata hidroksibenzoeve kiseline koji su, skupa sa ostalim aktivnim sastojcima, kako fenolne tako i nefenolne prirode, odgovorni za njegov visok antioksidativni potencijal.

Blueberry wine – a good natural source of phenolic acids

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It is well known that blueberry (*Vaccinium myrtilus*) possesses a broad range of different compounds exhibiting beneficial health effects on humans. It can be consumed as a raw or processed fruit, including wine.
The examined wine samples were produced by microvinification procedure. The control fermentation of blueberry must was conducted using selected yeast cultures. Enzyme and sugar were added in part of the samples before fermentation, due to the increasing of phenolic compounds content of the final product. While total phenolic content (TPC) was spectrophotometrically determined by Folin-Ciocalteu method, single polyphenolics were quantified using UPLC TQ-MS/MS. Finally, Ferric Reducing Antioxidant Power (FRAP assay) and anti-DPPH radical activity were also estimated.
The applied microvinification procedure significantly affected both polyphenolic profiles and antioxidant potentials of the examined samples. Indeed, the wine enriched with polyphenolics and enhanced antioxidative affinity was produced with addition of enzyme and sugar before start of fermentation. However, an opposite trend was observed for a control sample, produced without addition of enzyme and sugar. Among quantified polyphenolics hydroxybenzoic acid derivatives stood out: specifically, vanillic, protocatechuic and *p*-hydroxybenzoic acids. TPC and FRAP values were in the ranges 2135.77-2357.23 mg GAE/L and 63.27-76.32 mmol/L Fe^{2+}, respectively. On the other hand, anti-DPPH radical activity (expressed as an IC_{50} value) ranged from 1.37 to 1.64%.
In summary, blueberry wine may be considered as a rich natural source of hydroxybenzoic acid derivatives that are, jointly with other active principles – both phenolics and non-phenolics, responsible for its high antioxidant potential.

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BKHP13 / FQSP13

Uticaj mikrovinifikacije na anti α-glukozidaznu aktivnost vina od maline

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Malina (*Rubus idaeus*), jedan od najznačajnijih poljoprivrednih proizvoda u našoj državi, predstavlja bogat izvor bioaktivnih supstanci, od kojih su pojedine inhibitori enzima od posebnog značaja za ljudski organizam.
Ispitivani uzorci vina proizvedeni su različitim postupcima mikrovinifikacije. Naime, u pojedine uzorke, pre fermentacije, pridodati su i šećer i enzim, kako bi se povećao sadržaj polifenolnih jedinjenja u krajnjem proizvodu. Anti α-glukozidazna inhibitorna aktivnost određena je u *in vitro* uslovima standardnom metodom. Konačno, sadržaj pojedinačnih polifenola (kvantifikovanih pomoću UPLC TQ-MS/MS) koreliran je sa datom biološkom aktivnošću, radi utvrđivanja potencijalnih bioaktivnih principa.
Primenjeni postupak mikrovinifikacije uslovio je značajne razlike u polifenolnom profilu i anti α-glukozidaznoj aktivnosti. Zapravo, vino proizvedeno sa dodatkom šećera i enzima pre početka fermentacije izdvojilo se kako po sadržaju polifenola, tako i po biološkoj aktivnosti. Inhibitorna aktivnost (predstavljena kao vrednost IC_{50}) kretala se u opsegu od 35 do 47 µg/mL. Među kvantifikovanim polifenolima, trebalo bi istaći derivate hidroksicimetne kiseline kiseline, konkretno, hlorogenu, *p*-kumarinsku i kafeinsku kiselinu. Određivanjem inhibitorne aktivnosti odgovarajućih standarda pokazano da je da kafeinska kiselina ponajviše doprinosi anti α-glukozidaznoj aktivnosti.
Dakle, vino od maline potencijalno bi se moglo primeniti kao funkcionalna (medicinska) hrana u prevenciji dijabetesa i drugih hroničnih bolesti.

The impact of microvinification on anti α-glucosidase activity of raspberry wine

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Raspberry (*Rubus idaeus*), one of the most important agricultural products in our country, represents a rich source of bioactive compounds, of which some of them are known as the inhibitors of enzyme compounds of particular importance for human organism.
The analyzed wine samples were produced by different microvinification procedures. In order to increase polyphenolic content of the final product, both sugar and enzyme were added in part of the samples before fermentation. Anti α-glucosidase activity was determined by standard method at *in vitro* conditions. Finally, the content of single polyphenolics (quantified using UPLC TQ-MS/MS) was correlated with the observed biological activity, due to the estimation of potential bioactive principles.
The applied microvinification procedure significantly affected polyphenolic profile and anti α-glucosidase activity. Indeed, the wine sample produced with addition of both sugar and enzyme before start of fermentation stood out for its polyphenolic content and biological activity. The inhibitory activity (expressed as an IC_{50} value) was in the range from 35 to 47 µg/mL. Among quantified polyphenolic compounds, hydroxycinnamic acid derivatives such as chlorogenic, *p*-coumaric and caffeic acids should be emphasized. On the basis of the relevant findings for standard compounds, caffeic acid was found to predominantly contribute to anti α-glucosidase activity.
In summary, raspberry wine may be potentially used as a functional (medicinal) food in the prevention of diabetes mellitus and other chronic diseases.

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Sinergistička antineurodegenerativna aktivnost ekstrakata *Ganoderma lucidum* i *Salvia officinalis*

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Ganoderma lucidum i *Salvia officinalis* su visoko cenjene lekovite vrste zahvaljujući dokazanim brojnim aktivnostima kao što su antioksidativna, citotoksična, antimikrobna, itd. Međutim, malo je podataka o njihovom neuroprotektivnom potencijalu i još uvek nema objavljenih studija o njihovim sinergističkim efektima. Kako su neurodegenerativne bolesti glavni uzroci smrti starije populacije u razvijenim zemljama i obzirom da komercijalni lekovi ne daju zadovoljavajuće rezultate i imaju brojne neželjene efekte, sve je veći interes za pronalaženjem prirodnih neuroprotektivnih sredstava. Tako je cilj studije bio da se ispita potencijalni sinergistički efekat vodenih i etanolnih (70%) ekstrakata *G. lucidum* i *S. officinalis* u inhibiciji acetilholinesteraze (AChE) i tirozinaze (Tyr), enzima uključenih u neurodegenerativne procese. Bazidiokarpi *G. lucidum* su dobijeni u laboratorijskim uslovima, a nadzemni delovi *S. officinalis* su sakupljeni u Valdanosu (Crna Gora). U istraživanju su postavljena dva eksperimentalna modela: mešanje usitnjenog materijala *G. lucidum* i *S. officinalis* pre ekstrakcije i mešanje ekstrakata *G. lucidum* i *S. officinalis*, u odnosima (%): 70:30; 50:50; 30:70. Nivo inhibicije AChE i Tyr je određen spektrofotometrijski. Mešavina etanolnih ekstrakata (u koncentraciji od 100 µg/mL) u odnosu 30% gljiva i 70% biljka pokazala je najviši nivo inhibicije AChE (32.91%). Maksimalni sinergizam je dobijen za mešavinu vodenih ekstrakata u odnosu 50%:50% (u koncentraciji od 200 µg/mL) kada je AChE inhibirana za 29.63%, što je oko 2.6 puta više od kontrolnog ekstrakta *S. officinalis* i oko 40% od ekstrakta *G. lucidum*. Nivo inhibicije Tyr bio je izuzetan, sa maksimumom od 65% za mešavinu vodenih ekstrakata u odnosu 30% gljiva:70% biljka (u koncentraciji od 200 µg/mL). Dobijeni rezultati su obećavajući jer je po prvi put pokazan sinergistički efekat ekstrakata *G. lucidum* i *S. officinalis*, koji ukazuje na nove mogućnosti pronalaženja prirodnih neuroprotektivnih sredstava.

Synergistic antineurodegenerative effect of *Ganoderma lucidum* and *Salvia officinalis* extracts

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Ganoderma lucidum and *Salvia officinalis* are highly valued medicinal species owing to their numerous capacities such as antioxidative, cytotoxic, antimicrobial, etc. However, there is a little data on their neuroprotective potential and reports about their synergistic effects have not yet been published. As neurodegenerative diseases are the main causes of elderly population death in developed countries and commercial drugs do not give satisfactory results and have numerous side effects, there is increasing interest in finding natural neuroprotective agents. Thus, the aim of the study was to examine the potential synergistic effect of *G. lucidum* and *S. officinalis* hot water and 70%-ethanol extracts for inhibiting acetylcholinesterase (AChE) and tyrosinase (Tyr), enzymes involved in neurodegenerative processes. The fruiting bodies of *G. lucidum* were cultivated in a laboratory conditions and *S. officinalis* was harvested in Valdanos (Montenegro). Two experimental designs were applied: mixing of grounded *G. lucidum* and *S. officinalis* material before extraction and mixing of *G. lucidum* and *S. officinalis* extracts, in the ratios (%): 70:30; 50:50; 30:70. The level of AChE and Tyr inhibition was determined spectrophotometrically. The mixture of ethanol extracts (conc. 100 µg/mL) in the ratio of 30% mushroom and 70% plant showed the highest level of AChE inhibition (32.91%). The maximum synergism was obtained for the mixture of hot water extracts (conc. 200 µg/mL) in a ratio 50%:50%, when AChE was inhibited for 29.63%, about 2.6-fold better than *S. officinalis* extract and about 40% of *G. lucidum* extract. The level of Tyr inhibition was extraordinary, with maximum of 65% for mixture of 30% mushroom: 70% plant hot water extracts (conc. 200 µg/mL). Since no study has been conducted on the synergistic effect of *G. lucidum* and *S. officinalis* extracts until now, the obtained results are promising, indicating new possibilities for finding natural neuroprotective agents.

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Bioakumulacija arsena i pojedinih teških metala u tkivima puževa poreklom iz Srbije

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Kratak izvod: Cilj ovog istraživanja je bio da se utvrdi koncentracija arsena i pojedinih teških metala (olovo, živa, bakar, kadmijum, cink, gvožđe i mangan) u tkivu puževa (stopalo i utroba) sa farme puževa u Srbiji. Uzorci puževa analizirani su korišćenjem atomskog apsorpcionog spektrofotometra (GBC 932 plus atomski apsorpcioni spektrometar, GBC Scientific Equipment, USA). Tačnost metode potvrdjivana je referentnim materijalom. Rezultati su predstavljeni kao srednja vrednost ± SD (standardna devijacija). U ovom istraživanju bilo je uključeno ukupno 730 pojedinačnih uzoraka puževa. Uzorci puževa sakupljani su u plastične kese i transportovani u laboratoriju Fakulteta veterinarske medicine, Univerziteta u Beogradu. Puževi su oprani destilovanom vodom, a stopala i utroba su odmah secirani. Ova tkiva su ispitivana jer se najčešće prijavljuju kao izvor akumulacije teških metala. Nivoi arsena, olova i žive u ispitivanim uzorcima puževa bili su ispod granice detektovanja. Koncentracija bakra u tkivu puža iznosila je 29,08 ± 3,03 mg kg^{-1} u uzorcima stopala, a 22,47 ± 1,96 mg kg^{-1} u utrobi. Koncentracija kadmijuma u uzorcima stopala iznosila je 0,12 ± 0,02 mg kg^{-1} i 2,81 ± 0,38 mg kg^{-1} i utrobi. Koncentracija cinka u tkivima stopala iznosila je 11,69 ± 0,83 mg kg^{-1}, a 21,19 ± 2,26 mg kg^{1} i utrobi. Koncentracija gvožđa u utrobi iznosila je 46,90 ± 6,78 mg kg^{-1}, a u uzorcima stopala iznosila je 10,07 ± 0,94 mg kg^{-1}. Koncentracija mangana u utrobi iznosila je 64,24 ± 7,04 mg kg^{-1}, a u uzorcima stopala iznosila je 2,27 ± 0,19 mg kg^{-1}. Utvrdjene su varijacije u različitim uzorcima tkiva puževa u bioakumulaciji teških metala. Koncentracija teških metala bila je veća u uzorcima utroba puževa u odnosu na uzorke tkiva stopala. Uzorci puževa mogu se koristiti kao dobar bioindikator za praćenje koncentracije teških metala.
Ključne reči: teški metali, stopalo, utroba, monitoring, zagađenje životne sredine.
Zahvalnica: Rad je deo projekta TR 31034, koje finansira Ministarstvo prosvete, nauke i tehnološkog razvoja Republike Srbije.

Bioaccumulation of arsenic and heavy metals in snail tissues from the Serbia

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Abstract: The aim of this study was to determined arsenic and heavy metal concentration (lead, mercury, copper, cadmium, zinc, iron and manganese) in snail tissus (foot and digestive gland) from snail farm in Serbia. Snail samples were analysed by using atomic absorption spectrophotometer (GBC 932 plus atomic absorption spectrometer, GBC Scientific Equipment, USA). The accuracy of method is validated by certified reference material. The results were presented as mean ± SD (Standard Deviation). Total of 730 individual snails were included in this study. Snail samples were put in plastic bags and transported to the laboratory of Faculty of Veterinary Medicine, University of Belgrade. The snails were washed with distilled water, and the foot and digestive glands were fast dissected out. This tissues were examinated because there are most often reported as the mail source for heavy metal accumulation. The levels of arsenic, lead and mercury in examinated snail simples were below detectable limit. The cooper concentration in snail tissues was 29.08±3.03 mg kg^{-1} in foot samples, and 22.47±1.96 mg kg^{-1} in digestive gland. The cadmium concentration in foot samples was 0.12±0.02 mg kg^{-1}, and 2.81±0.38 mg kg^{-1} in digestive gland. The zinc concentration in foot tissues was 11.69±0.83 mg kg^{-1}, and 21.19±2.26 mg kg^{-1} in digestive gland. The iron concentration in digestive gland was 46.90±6.78 mg kg^{-1}, and in foot samples was 10.07±0.94 mg kg^{-1}. The manganese concentration in digestive gland was 64.24±7.04 mg kg^{-1}, and in foot samples was 2.27±0.19 mg kg^{-1}. There are a variations from the tissues to another in heavy metals bioaccumulation. Concentration of heavy metals was higher in digestive gland tissues compared with foot tissues. The snail samples can be used as a good bioindicator for heavy metals concentration monitoring.

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Određivanje sadržaja natrijuma i jodata u komercijalnim kuhinjskim solima

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U ovom radu ispitivan je sadržaj natrijuma i jodata u kuhinjskim solima dostupnim na tržištu Republike Srpske. Kuhinjska so, odnosno natrijum hlorid, je glavni izvor jona natrijuma, Na^+, kao i hloridnih jona, Cl^-, za ljude i životinje. Joni natrijuma, Na^+, imaju ključnu ulogu u mnogim fiziološkim procesima, od održavanja stalnog krvnog pritiska, do održavanja funkcije nervnog sistema. Optimalan unos joda je od izrazite važnosti za zdravlje, a nedovoljan unos joda uzrokuje brojne razvojne i funkcionalne poremećaje koji se nazivaju poremećaji uzrokovani nedostatkom joda. Jodiranje kuhinjske soli i soli koja se koristi u prehrambenoj industriji najbolja je preventivna mjera sprečavanja poremećaja uzrokovanih nedostatkom joda na nivou određene populacije. Prema zakonskoj regulativi koja je na snazi u Bosni i Hercegovini so za ljudsku upotrebu treba da sadrži najmanje 97% NaCl računato na suvu materiju i 20-30 mg elementarnog joda po kg kuhinjske soli. Jodiranje se treba vršiti uz pomoć KIO_3. Za analizu je uzeto pet različitih vrsta soli (Tuzlanska so, So komerc plus, Panonija so, Paška morska so i Himalajska so) dostupnih na našem tržištu, koje su kupljene u lokalnim marketima u Banjaluci. Određivanje sadržaja jona natrijuma, Na^+ i jodata IO_3^- izvršeno je potenciometrijskom metodom, odnosno volumetrijskom metodom. Za potenciometrijska mjerenja korišćena je natrijumova jon-selektivna elektroda. Za određivanje jodata korišćen je standardni rastvor natrijum tiosulfata. Udeo natrijumovih jona određen je na osnovu kalibracione krive za standardne rastvore NaCl. Četiri uzorka su pokazala dobro slaganje sa pravilnikom, dok je kod jednog uzorka uočeno odstupanje. Sadržaj prisutnih jodata je bio ispod granice koja je propisana zakonskom regulativom. Autori smatraju da prisutno odstupanje može biti usled neadekvatnog skladištenja soli.

Determination of natrium and iodate ions content in commercial salts

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The content of sodium and iodate ions in commercial salts available in the Republika Srpska market was determined. The salt, or sodium chloride, is the main source of sodium ions, Na^+, as well as chloride ions, Cl^-, for humans and animals. The sodium ions play a key role in many physiological processes, from maintaining constant blood pressure to maintenance of the function of the nervous system. The optimal intake of iodine is of great importance for health, also, and insufficient iodine intake causes numerous developmental and functional disorders called disorders caused by iodine deficiency. Iodization of table salt and salt used in the food industry is the best preventive measure of the prevention of disorders caused by the lack of iodine at the level of a certain population. According to the current law legislation in Bosnia and Herzegovina, a commercial salts should contain at least 97% NaCl calculated on dry matter and 20-30 mg of elemental iodine per kg of salt. Iodization should be done with KIO_3. For this research, five different types of salts were taken (Tuzla salt, Salt komerc plus, Panonija salt, Paška sea salt and Himalai salt) from local markets in Banja Luka. Determination of the content of sodium ions, Na^+ and iodate IO_3^- was carried out using the potentiometric method and volumetric method. For potentiometric measurements, sodium ion-selective electrode (ISE) was used. A standard solution of sodium thiosulfate was used for determination of iodine ions. The sodium ion content was determined based on the calibration curve for standard NaCl solutions. Four samples showed good agreement with the law regulation, while one pattern showed a deviation. The content of the iodates present was below the limit prescribed by the legislation. The authors believe that the present deviation may be due to the inadequate storage of commercial salt in stores or storage.

BKHP17 /BKHP17

Stabljika i lišće hajdučke trave kao izvori novih funkcionalnih sastojaka

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Hajdučka trava je jedna od najčešće korišćenih biljaka u tradicionalnoj medicini Srbije. Glavni nosioci farmakoloških aktivnosti hajdučke trave nalaze se u njenom cvetu, koji se koristi za pripremu čajeva i lekovitih preparata. Drugi delovi biljke, poput stabljike i listova, ostaju neupotrebljeni. U okviru ovog rada ispitani su ekstrakti hajdučke trave pripremljeni od njenih cvetova, stabljike i listova. Dobijeni rezultati su pokazali da ekstrakti lista imaju najviši sadržaj fenola i flavonoida (118.97 mg EHK/g i 98.13 mg ER/g). U pogledu antioksidativne aktivnosti, ekstrakti cvetova i stabljike su pokazali višu aktivnost u odnosu na lišće. Najveću sposobnost ka inhibiranju amilaze (0.51 mmol ACAE/g) i tirozinaze (23.54 mg KAEs/g) su ispoljili ekstrakti stabljike, dok su ekstrakti pripremljeni od listova izrazili najveću aktivnost pri inhibiranju glukozidaze (2.86 mmo lACAE/g). Predstavljeno istraživanje pokazuje da pored cvetova i drugi delovi hajdučke trave sadrže nosioce bioloških aktivnosti i da predstavljaju izvor molekula koji se mogu inkorporirati u različite funkcionlne proizvode (suplementi, dodaci ishrani, funkcionalne namirnice, i dr.).

Stalks and leaves of yarrow as sources of new functional ingredients

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Yarrow is one of the most popular plants in Serbian traditional medicine. The components responsible for its pharmacological activities are accumulated in its flowers, which is often used for the preparation of tea of phytopharmaceuticals. However, other parts (stalks, leaves, etc.) remain unused. In this work, the extracts prepared from flowers, stalks and leaves of yarrow were studied. The obtained results showed that the highest amount of phenols and flavonoids were found in the extracts prepared from leaves (118.97 mg CAE/g and 98.13 mg RE/g). Two antioxidant assays showed that flowers and stalks extracts express better activity than leaves. Stalks' extract was the most potent in terms of amylase (0.51 mmol ACAE/g) and tyrosinase (23.54 mg KAEs/g) inhibition, while extracts prepared from leaves express higher glucosidase-inhibition ability (2.86 mmol lACAE/g). The study shows that other parts of this plant could be used as a sources of bioactive compounds, which can be further incorporated in myard of functional products (suplements, functional food, etc.).

Savremen pristup dobijanja funkcionalnih sastojaka kamilice

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U okviru ovog rada cvast kamilice je ekstrahovana primenom dve različite tehnike, sa ciljem dobijanja proizvoda bogatog bioaktivnim jedinjenjima i funkcionalnim sastojcima. Za ovu svrhu, primenjena je jedna konvencionalna (Soxhlet extrakcija - SE) i jedna nekonvencionalna (superkritična ekstrakcija - SFE) tehnika. Detaljni hemijski sasatav SE i SFE ekstrakata je analiziran primenom GC - MS. Dodatno, izvršena je i procena biološke aktivnosti dobijenih ekstrakata. Prinos lipofine frakcije dobijene nakon tročasovne ekstrakcije čistim ugljen-dioksidom (350 bar i 40 °C) je bio približan prinosu ostvarenom SE ekstrakcijom u trajanju od 6 h pomoću metilen hlorida. Ispitivanje ekstarkata u smislu inhibicije acetilholinesteraze (AChE) i butirilholinesteraze (BChE) je pokazalo veći enzim-inhibitorni potencijala SFE uzorka. Imajući u vidu „zeleni" karakter i bezbednost SFE ekstrakata, prepoznat je veliki potencijal i mogućnost njihove primene kao sastojaka različitih prehrambenih funkcionalnih proizvoda, kao i brojnih farmaceutskih preparata.

Emerging approach for the preparation of chamomile functional ingredients

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In this study chamomile was extracted applying two different techniques in order to obtain the extract opulent with bioactive compounds. For this purpose one conventional (Soxhlet - SE) and one non-conventional (Supercritical fluid extraction - SFE) extraction technique were used. Detailed chemical composition of SE and SFE extracts was analysed by GC - MS. Additionally, biological activity of the chamomile products was examined as well. The yield of lipophilic fraction, achieved by 3h extraction, with CO_2 at 350 bar and 40 °C was close to that one produced by Soxhlet performed for 6 h with methylene chloride. On the other hand, examination of their ability to inhibit acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) showed much higher enzyme-inhibitory potential of SFE extracts. Due to their green character and safety, SFE extracts have a great potential and possibilities for their use as ingredients in both numerous functional food products and pharmaceutical products, are recognized.

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BKHP19 / FQSP19

Chromatographic profile of fatty acids and sugars in cupcakes functionalized with an extract rich in rosmarinic acid

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Currently, the food industry is interested in replacing artificial additives by natural ingredients. Some plant extracts have emerged as possible alternatives to artificial preservatives, namely antioxidants. In fact, dairy, meat and bakery products have been developed, incorporating extracts of aromatic plants, spices or fruits, which have antioxidant properties. In this work, the preserving effectiveness of an extract rich in rosmarinic acid was tested in cupcakes and compared to an artificial additive (potassium sorbate, E202). The extract was obtained from *Melissa officinalis* L. (lemon balm) by applying an ultrasound technique using a mixture of ethanol/water as the extraction solvent. After confirming its antioxidant properties (free radical scavenging effect EC_{50} = 79 ± 2 µg/mL; reducing power EC_{50} = 49 ± 1 µg/mL), antimicrobial (against 8 bacteria and 8 food contaminating fungi), and absence of toxicity (in cell lines), it was incorporated in cupcakes, and analysed immediately after incorporation and after 3 and 5 days of storage at room temperature and protected from light. All samples were analysed chromatographically in terms of fatty acids (GC-FID) and free sugars (HPLC-RI). Regarding fatty acids, a total of 21 molecules were identified, with predominance of saturated fatty acids in all cupcakes samples. Individually, palmitic acid and oleic acid were detected in the highest percentages. Among free sugars, sucrose (the major form) and glucose were identified in all samples. The results demonstrate that the addition of the extract rich in rosmarinic acid caused no changes in fatty acids and sugars' profiles, having the potential to be used in pastry products, meeting the current consumers demand.

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Hromatografski profil masnih kiselina i šećera u kolačima funkcionalizovanim ekstraktom bogatim rozmarinskom kiselinom

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Industrija hrane trenutno je veoma zainteresovana postojanjem mogućnosti zamene veštačkih aditiva prirodnim sastojcima. Izvesni biljni ekstrakti pojavili su se kao moguće alternative veštačkim konzervansima, pre svega antioksidanti. Štaviše, razvijaju se mlečni proizvodi, meso i proizvodi iz pekarske industrije koji u sebi sadrže ekstrakte aromatičnih biljaka, začina ili voća, a koji istovremeno pokazuju antioksidativna svojstva. U ovom radu ispitivana je efikasnost očuvanja ekstrakta bogatog rozmarinskom kiselinom u kolačima, koja je potom upoređena sa veštačkim aditivom (kalijum sorbat, E202). Ekstrakt je dobijen od biljke *Melissa officinalis* L. (matičnjak) primenom ultrazvučne tehnike koristeći smešu etanola/vode kao rastvarača za ekstrakciju. Nakon utvrđivanja antioksidativnih (efekat uklanjanja slobodnih radikala EC_{50} = 79 ± 2 µg/mL; smanjenje jačine EC_{50} = 49 ± 1 µg/mL) i antimikrobnih svojstava (protiv 8 bakterija i 8 gljiva koje zagađuju hranu), kao i utvrđivanja odsustva toksičnosti (u ćelijskim linijama), ekstrakt bogat rozmarinskom kiselinom dodat je u kolače i analiziran odmah nakon dodavanja, kao i nakon 3 i 5 dana skladištenja na sobnoj temperaturi i na mestu zaštićenom od svetlosti. Svi uzorci su analizirani hromatografski u smislu masnih kiselina (GC-FID) i slobodnih šećera (HPLC-RI). Kada su u pitanju masne kiseline, identifikovan je ukupno 21 molekul, sa najvećim procentom zasićenih masnih kiselina u svim uzorcima kolača. Pojedinačno, palmitinska kiselina i oleinska kiselina su detektovane u najvećem procentu. Od slobodnih šećera, saharoza (glavni oblik) i glukoza identifikovane su u svim uzorcima. Rezultati pokazuju da dodavanje ekstrakta bogatog rozmarinskom kiselinom nije prouzrokovalo promene u profilima masnih kiselina i šećera. Time je uočen potencijal korišćenja ovog ekstrakta u pecivima i pekarskoj industriji, imajući u vidu da uspešno zadovoljava trenutno potražnju među potrošačima.

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BKHP20 / FQSP20

Određivanje sadržaja sorbinske i benzojeve kiseline u paradajz sosu HPLC metodom

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Konzervansi, kao što su benzoeva kiselina (BA) I sorbinska kisleina (SA), su veoma bitni I igraju značajnu ulogu u transportu hrane I roku trajanja hrane. Konzervanski su ključni u odbrani hrane od mikroorganizama I mogu da utiču na izgled proizvoda. Korištenje konzervanasa je regulisano zakonskom regulativom svake zemlje posebno. Prema zakonskoj regulativi Republike Srpske, ukupan sadržaj sorbinske kiseline I benzoeve kiseline treba da bude manji od 1000 mg/kg računato na sumu oba konzervansa. Cilj rada je bio ispitivanje sadržaja Na benzoate I K sorbata u uzorcima paradajz sosa koji su bili kupljeni u lokalnim marketima u Republici Srpskoj. Dvadeset uzoraka je ispitivano pomoću HPLC-hromatografije, koristeći kolonu reverzne faze i UV detektor. Kolona reversnih faza koja je korištena je C8, 250mm x 4,6 mm, veličine čestica 5 µm. Koncentracije benzojeve i sorbinske kiseline su određene iz kalibracione krive. Svi ispitivani uzorci su bili u skladu sa zakonskom regulativom Republike Srpske i BiH.

Determination of sorbic and benzoic acid in tomato juice by HPLC method

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Food preservatives, such as sorbic acid (SA) and benzoic acid (BA) are very important and play significant role in food transportation and duration of food. Preservatives are crucial in protecting the food against the damages caused by microorganisms as well as appearance of food. The use of mentioned preservatives is subjected to the law regulation of each country. According to Law regulation of Republic of Srpska, limit of SA and BA is set to less then 1000mg/kg calculated as a sum of both preservative present in food product. The aim of this work was control of presence as well as content of benzoic and sorbic acid in tomato juices available in commercial stores in Republic of Srpska. Twenty samples were examined by HPLC chromatography using a reverse phase column and a UV detector. The reverse phase column used was C8, 250mm x 4.6mm, particle size 5µm. The concentration of benzoic and sorbic acid was determined from the calibration curve. All examined samples were in compliance with the legislation of Republika Srpska.

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BKHP21 / FQSP21

Koncentracije As, Cd, Cu, Fe, Hg, Pb i Zn u mišićnom tkivu skobalja, klena i soma sa akumulacije Međuvršje

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Tokom istraživanja sprovedenih 2012, 2013 i 2014. godine na akumulaciji Međuvršje prikupljeno je 67 jedinki skobalja, klena i soma. U mišićnom tkivu jedinki utvrđen je nivo akumulacije hazardnih elemenata (As, Cd, Cu, Fe, Hg, Pb, Zn) i upoređen sa MDK vrednostima propisanim regulativama i propisima naše zemlje, kao i FAO i EU. Uzorci mišića su testirani na prisustvo i koncentraciju odabranih elemenata primenom optičke emisione spektroskometrije (ICP-OES). Prikupljanje ihtiološkog materijala na akumulaciji vršeno je pomoću seta stajaćih ribarskih mreža promera okaca 10–80 mm. Akumulacija Međuvršje se nalazi u izlaznom delu Ovčarsko-kablarske klisure. Tok Zapadne Morava uzvodno od akumulacije karakteriše intenzivna emisija industrijskih, komunalnih i otpadnih voda iz seoskih domaćinstava s obzirom da nijedno naselje niti fabrika ne poseduju sisteme za prečišćavanje vode. Riblje vrste korišćene u ovom istraživanju predstavljaju najčešće lovljene i najatraktivnije ribolovne vrste akumulacije Međuvršje koje se koriste u ljudskoj ishrani.
Cilj rada je sagledavanje bezbednosti upotrebe mesa tri vrste riba u ljudskoj ishrani sa stanovišta prisustva hazardnih elemenata i poređenje sa propisanim graničnim vrednostima (MDK).
Izmerene vrednosti elemenata su bile višestruko ispod propisanih MDK vrednosti. Vrednosti arsena bile su u opsegu 0,057-0,153 μg/g, a najviše vrednosti zabeležene su kod skobalja. Kadmijum je registrovan samo 2013. godine u mišićnom tkivu klena (0,002 μg/g). Vrednosti bakra kretale su se u opsegu 0,006-0,132 μg/g, a najviše vrednosti bile su kod klena; Fe je bio u opsegu 0,503-8,79 μg/g, a najviše vrednosti su bile kod soma; Hg je bio u opsegu 0,043-0,077 μg/g, a najviše vrednosti bile su kod klena; Pb je bio u opsegu 0,03-0,134 μg/g, a najviše vrednosti bile su kod soma, a Zn je bio u opsegu 1,387-20,049 μg/g, a najviše vrednosti bile su kod klena. Izneti rezultati ukazuju na bezbednu upotrebu analiziranih vrsta riba za ljudsku ishranu.

Concentrations of As, Cd, Cu, Fe, Hg, Pb and Zn in muscle tissue of common nase, chub and wels catfish from the Medjuvršje reservoir

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During the survey conducted in 2012, 2013 and 2014, 67 specimens of common nase, chub and wels catfish were collected on the Medjuvršje reservoir. In the muscle tissue of the individual, the level of accumulation of hazardous elements (As, Cd, Cu, Fe, Hg, Pb, Zn) is determined and compared with the MAC values established by the national regulations and legislation, as well as FAO and EU. Muscle samples were tested for the presence and concentration of selected elements using optical emission spectroscopy (ICP-OES). Collection of ichthyological material on the reservoir was carried out using a set of fishing nets with a diameter of 10-80 mm. Reservoir Međuvršje is located in the outlet of the Ovčarsko-Kablar gorge. The Zapadna Morava River upstream of the accumulation is characterized by an intensive emission of industrial, communal and wastewater from rural households, since no settlements or factories do not have systems for water purification. The fish species used in this research are the most frequently fished and most attractive fishing types of Međuvršje reservoir used in human nutrition.
The aim of the paper is to examine the safety of meat use of three fish species in human nutrition from the point of view of the hazardous elements presence and comparison with the prescribed limit values (MAC).
The measured values of the elements were several times below the prescribed MAC values. Arsenic values were in the range 0.057-0.153 μg/g and the highest values were recorded in common nase. Cadmium was only registered in 2013 in the chub muscle tissue (0.002 μg/g). Copper values ranged 0.006-0.132 μg/g and the highest values were in chub; Fe was in the range 0.503-8.79 μg/g and the highest values were in the wels catfish; Hg was in the range 0.043-0.077 μg/g and the highest values were in chub; Pb was in the range 0.03-0.134 μg/g and the highest values were in the wels catfish, and Zn was in the range 1.387-20.049 μg/g and the highest values were in chub. The results show a safe use of the analyzed fish species for human consumption.

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BKHP22 / FQSP22

Poboljšanje kvaliteta bezglutenskog hleba dodatkom vlakana šećerne repe

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Prehrambena industrija se suočava sa velikim izazovima u proizvodnji bezglutenskog hleba posebno po pitanju njegovog kvaliteta i nutritivne adekvatnosti. Bezglutenski hlebovi dostupani na tržištu obično se karakterišu brojnim nedostacima kao što su redukovana zapremina, slabo razvijena i mrvljiva sredina hleba i loše senzorske osobine. U cilju prevazilaženja navedenih tehnoloških nedostataka prehrambena vlakna mogu biti upotrebljena u bezglutenskim formulacijama uzimajući u obzir njihove hidratacione osobine, sposobnost formiranja gela i zgušnjavanja. Sagledavajući već naučno dokazane pozitivne zdravstvene efekte prehrambenih vlakana, njihovom primenom moguće je dobiti novi funkcionalni proizvod poboljšanog tehnološkog i nutritivnog profila koji će zadovoljiti potrebe potrošača i sa zdravstvenog i hedonističkog aspekta.
Cilj predstavljenog istraživanja je da pokaže potencijal primene vlakana šećerne repe dobijenih iz ekstrahovanih rezanaca za poboljšanje nutritivnog kvaliteta bezglutenskog hleba bez narušavanja njegovih kvalitetnih (zapremine, teksture, boje) i senzorskih karakteristika. Eksperimenti su izvedeni prema Box-Behnken dizajnu sa nezavisno promenljivim parametrima: količina vlakana šećerne repe (3, 5 i 7% na masu brašna), količina hidroksipropilmetilceluloze (HPMC) (2, 3 i 4% na masu brašna) i količina vode (200, 210 i 230% na masu brašna).
Dodatak vlakana šećerne repe blago je povećao zapreminu bezglutenskog hleba u formulacijama sa 3 i 4% HPMC istovremeno smanjiujući tvrdoću sredine hleba. Na svetloću (L^*) kore bezglutenskog hleba dodatak vlakana šećerne repe nije imao uticaj. Bezglutenski hlebovi formulisani sa 4% HPMC i 3, 5 ili 7% vlakana šećerne repe senzorno su ocenjeni najvišim ocenama (36,8–40,0 boda) i imali su odličan kvalitet. Navedeni bezglutenski hlebovi karakterisali su se dobrim ukusom, mekom sredinom sa ujednačenim porama srednje veličine, žutom bojom, svežim izgledom i velikom zapreminom.

Gluten-free bread quality enhancement by sugar beet fibre application

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The food industry faces major challenges in gluten-free (GF) bread production especially in terms of bread quality and nutritional adequacy. GF breads available on the market usually have numerous quality defects including reduced volume, poorly developed cell structure, a dry, crumbly texture and poor sensory characteristics. To address aforementioned technological problems dietary fibres (DF) can be applied in GF formulations considering their hydration and gel forming ability, textural and thickening effects. Taking into account proved DF positive health outcomes it will be possible to obtain a new functional product with an improved nutritive and technological profile that will satisfy the needs of consumers in the health and hedonistic sense.
In this regard presented study aims to show how a fibrous by-product from sugar beet processing (sugar beet fibre (SBF) obtained from sugar beet pulp) can potentially be used to improve the GF bread nutritional quality while not compromising on the bread properties (volume, texture, colour) and sensory acceptability. Experiments were performed according to Box-Behnken experimental design, with independent variables: quantity of SBF (3, 5, and 7% on maize flour basis), quantity of hydroxypropylmethylcellulose (HPMC) (2, 3 and 4% on maize flour basis) and quantity of water (210, 220 and 230% on maize flour basis).
SBF application slightly increased GF bread loaf volume in formulations with medium and high HPMC content while simultaneously decreased crumb hardness. Crumb brightness (parameter L*) was not affected by SBF addition. GF breads formulated with 4% HPMC and 3, 5, 7% SBF received the highest scores upon sensory evaluation (36.8–40.0 points) and had excellent quality. The aforementioned GF breads had fine taste, soft crumb texture with medium size air pores of good uniformity, yellow colour, fresh appearance and high loaf volumes.

Određivanje sadržaja nutritivnih komponenti u biljnim uljima

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Jestiva biljna ulja sadrže esencijalne nutrijente i njihov svakodnevni unos je neophodan. Najzastupljenije masne kiseline u biljnim uljima su nezasićene masne kiseline, a vitamin E prisutan je u vidu izomera α-, β-, γ- i δ- tokoferola. Cilj ove studije bio je određivanje sadržaja masnih kiselina i vitamina E u različitim vrstama biljnih ulja, kao i njihovo međusobno poređenje.
Ispitivana su ulja 12 različitih biljnih vrsta: ulje kokosa, koštica kajsije, palme, kikirikija, crnog kima, badema, susama, tikve, pšeničnih klica, masline, lana i konoplje. Masne kiseline su prevođene u isparljive metil estre pomoću 3M rastvora HCl u metanolu i određivane metodom gasne hromatografije. Priprema uzoraka za određivanje vitamina E se vršila rastvorom KOH u 95% etanolu, nakon čega se sadržaj ispitivao HPLC metodom. Sadržaj masnih kiselina je prikazan kao procentualni udeo u odnosu na ukupne masne kiseline, dok je sadržaj vitamina E izražen u mg/kg biljnog ulja.
U ispitivanim uljima u najvećoj količini su bile zastupljene nezasićene masne kiseline, sa izuzecima kokosovog i palminog ulja u kojima je određen veći sadržaj zasićenih masnih kiselina (93,8 i 50,8% redom). Najveća količina polinezasićenih masnih kiselina (PMK) određena je u ulju konoplje (72,3%). Oleinska kiselina se u najvećem procentu nalazila u maslinovom ulju (77,2%), dok je najveći sadržaj α- linolenske pronađen u lanenom ulju. Korelacija koja postoji između visokog procenta PMK i zastupljenosti vitamina E u biljnim uljima, primećena je i u ovoj studiji. Najveći sadržaj ukupnih tokoferola određen je u susamovom ulju (159,95 mg/kg), dok je procenat PMK bio 43,3%. Utvrđeno je da postoji korelacija između sadržaja PMK i količine vitamina E. Takođe je utvrđeno da količina vitamina E u ovim uljima u najvećoj meri potiče od γ izomera vitamina E.

Determination of nutritive compounds in vegetable oils

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Edible vegetable oils belong to the group of basic nutrients and their daily intake is necessary. The most common fatty acids in vegetable oils are unsaturated fatty acids, and vitamin E is present in the form of isomers of α-, β-, γ- and δ-tocopherols. The aim of this research was to determine content of fatty acids and vitamin E in different vegetable oils, as well as their mutual comparison.
The analysis included 12 different types of vegetable oils: coconut oil, apricot kernel, palm, peanut, black cumin, almond, sesame, gourd, wheat germ, olive, flax and cannabis oil. Fatty acids were evaporated to volatile methyl esters with 3M HCL in methanol and analysed using gas chromatography. Preparation of samples for determination of vitamin E was done with KOH in 95% ethanol, and than vitamin E was determined by HPLC method.
Fatty acid content is presented as a percentage of total fatty acids and vitamin E is expressed in mg/kg of vegetable oil. Unsaturated fatty acids were the most abundant in all analysed samples, except of coconut and palm oil with higher amount of saturated fatty acids (93.8% and 50.8% respectively). The highest amount of polyunsaturated fatty acids (PUFA) was shown in cannabis oil (72.3%), oleic acid in olive oil (77.2%), and α-linoleic acid in flaxseed oil. Correlation which exists between the high percentage of PUFA and amount of vitamin E in vegetable oils, was noted in this study. The largest amount of total tocopherols was found in sesame oil (159.95 mg/kg), while the percentage of the PUFA was 43.3%.
There is a correlation between content of PUFA and the amount of vitamin E. It has also been found that the amount of vitamin E in these oils is largely derived from γ isomers of vitamin E.

ICP-OES analiza ekstrakata lista koprive

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Osušeni list koprive je ekstrahovan pomoću dve konvencionalne (maceracija i *Soxhlet* ekstrakcija) i dve nekonvencionalne (ultrazvučna i mikrotalasna) ekstrakcione metode. Ekstrakti su ispitivani ICP-OES (indukovano kuplovana plazma sa optičkom emisionom spektroskopijom) tehnikom. Sadržaji makro i mikroelemenata su bili veći u ekstraktima dobijenim nekonvencionalnim ekstrakcionim metodama, dok je sadržaj toksičnih elemenata bio najmanji u ekstraktu koji je dobijen mikrotalasnom ekstrakcijom.

ICP-OES analysis of stinging nettle leaves extracts

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Stinging nettle leaves were extracted using two conventional (maceration and Soxhlet extraction) and two non-conventional (ultrasound and microwave extraction) extraction methods. Obtained extracts were further analyzed using ICP-OES (inductively coupled plasma-optical emission spectroscopy). Results showed that non-conventional extracts content of macro and microelements was higher than those in conventional extracts. Furthermore, content of toxic elements was the lowest in microwave extract.

Antibakterijaska i antioksidativna aktivnost medova iz različitih regiona Srbije

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Med je kompklesan prirodni proizvod koji može biti i hrana i lek. Njegovim konzumiranjem osim hranljive vrednosti, ne smemo zanemariti biološku aktivnost. U ovom radu je ispitan antimikrobni i antioksidativni potencijal 20 multifloralnih i monofloralnih uzoraka meda iz različitih regiona Republike Srbije.
Antibakterijska aktivnost je u velikoj meri vezana za koncentraciju vodonik preoksida (H_2O_2), koji se formira enzimskom konverzijom glukoze uz pomoć glukoza oksidaze. Najverovatniji mehanizam na kome se zasniva antibakterijsko dejstvo je oksidativno oštećenje i degradacija DNK bakterija. Antibakterijsko dejstvo medova je testirano na dva standardna soja bakterija, gram negativna *Escherichia coli* i gram pozitivna *Staphylococcus aureus*, zasejanim na Tripton soja agar hranljivoj podlozi. Uzorci su inkubirani na 30 °C / 72 h, a rezultat je izražen kao procenat redukcije bakterijskih sojeva. Za određivanje antioksidativne aktivnosti uzoraka meda korišćen je DPPH test. Kao standard korišćen je trolox. Za ispitivanje antioksidativnog potencijala primenjen je i TEAC test, a rezultati su izraženi kao µmol Trolox ekvivalenta (TE) po g uzorka.
Svi uzorci meda testirani u ovom radu su pokazali antibakterijsku aktivnost prema oba ispitivana soja bakterija. Ipak, aktivnost je više izražena u odnosu na gram negativnu *E. coli*. Procenat inhibicije se kreće u opsezima 5-92% za *E. coli* i 0-67,7% za *S. aureus*. Značajno je da medovi koji pokazuju izraženu aktivnost prema gram negativnim pokazuju nisku aktivnost prema gram pozitivnim bakterijama. Najizraženiji primer je uzorak meda od lipe koji 71.4% inhibira rast *E. coli*, a ne pokazuje značajnu inhibiciju soja *S. aureus*. Rezultati primenjenih testova za procenu kapaciteta hvatanja slobonih radikala (DPPH u opsegu: 22,96-79,45% i TEAC u opsegu: 3,34 - 23,04 µmol TE/g) ukazuju na značajan antioksidativni potencijal ispitivanih uzoraka meda.

Antibacterial and Antioxidant Activity of Honeys from Different Regions of Serbia

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Honey is complex natural product that can be used both, as food and medicine. By consumption, in addition to its nutritional value, we should not neglect the biological activity. In this work the antibacterial and antioxidant potential of 20 multifloral and monofloral honey samples from different regions of the Republic of Serbia were tested. Antibacterial properties of honey largely depend on concentration of hydrogen peroxide (H_2O_2), generated by glucose oxidase (GOx)-mediated conversion of glucose. The most probable bacterial-killing mechanism is based on oxidative damage and bacterial DNA degradation. The study of antibacterial activity of honey was tested on standard strains of gram negative and gram positive bacteria, *E. coli* and *S. aureus*, seeded on the nutritious substrate of Tripton soybean agar. Samples were incubated at 30 °C/72 h, and antibacterial activity is expressed as percentage of inhibition of bacterial growth. The antioxidant activity of honey samples was tested by DPPH assay, Trolox was used as standard. Antioxidant activity was also tested by TEAC assay where the results were presented as micromoles of Trolox equivalent (TE) per gram of sample.
All honeys tested in this study showed antibacterial activity. However, *E. coli* was more sensitive then *S. aureus.* The inhibition of bacterial growth was observed in the range 5 - 92% and 0 - 67.7% for *E. coli* and *S. aureus*, respectively. For example, Tilia honey sample exhibited 71.4% activity against *E. coli* and with no significant activity against *S. aureus*.The obtained results of applied tests for free-radical scavenging capacity (DPPH range: 22.96-79.45% and TEAC range: 3.34 - 23.04 µmol TE/g) indicate a significant antioxidant potential of the tested samples.

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Antioksidativni potencijal bukovače (*Pleurotus ostreatus)* uzgajane na supstratu sa različitim sadržajem komine grožđa i slame

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Oksidativni stres prouzrokovan poremećajem metabolizma i oslobađanjem reaktivnih vrsta kiseonika (ROS) dovodi do raznih zdravstvenih poremećaja. Sintetički antioksidanti mogu poboljšati prirodni odbrambeni mehanizam, ali zbog njihovog potencijalno toksičnog efekta, prednost se daje prirodnim sastojcima. *Pleurotus ostreatus* (Jacq. ex Fr.) P. Kumer (1871) (bukovača) je jedna od najčešće gajenih gljiva u svetu, zahvaljujući tome što je prilagodljiva različitim supstratima, a ima specifičan blag ukus ostriga pri kulinarskoj obradi. Zbog prisustva brojnih aktivnih komponenti poseduje spsobnost snižavanja holesterola, regulacije nivoa glukoze u krvi, prevenciju artritisa, antibakterijsku, antioksidativnu, antitumornu i antivirusnu aktivnost.
Cilj ovog rada bio je praćenje uticaja supstrata sa odgovarajućim sadržajem komine grožđa na antioksidativni potencijal *P. ostreatus*, i njegove promene od dana branja tokom skladištenja 7. i 14. dana. Za gajenje bukovače korišćen je supstrat koji se sastojao od komine grožđa i slame (20:80%). Plodonosna tela su osušena na 55°C i samlevena do finog praha, od koga je dobijen inicijalni ekstrakt postupkom vrele vodene ekstrakcije na 75-85°C tokom 1,5 h. Svaki ekstrakt je analiziran u opsegu koncentracija od 0.625-40 mg/mL. Za merenje antioksidativnih svojstava ispitivanih ekstrakata u *in vitro* uslovima, korišćene su metode sposobnost hvatanja slobodnih DPPH i $ABTS^+$ radikala, a antioksidativna sposobnost izražena je u EC_{50} (mg/mL) vrednostima.
Analizirani ekstrakti pokazali su sledeće rezultate: EC_{50} vrednosti za sposobnost hvatanja DPPH 0., 7. i 14. dana su bile 30.25, 29.24 i 19.9 mg/mL. Sposobnot hvatanja $ABTS^+$ radikala dobijenih 0., 7. i 14. dana su pokazale sledeće EC_{50} vrednosti: 8.1, 8.5 i 2.6 mg/mL. Svi analizirani ekstrakti su ispoljili dobru antioksidativnu aktivnost. Obe metode su potvrdile smanjenje EC_{50} vrednosti i povećanje antioksidativnog potencijala sa porastom broja dana skladištenja.

Antioxidative potential of the Oyster mushroom (*Pleurotus ostreatus)* cultivated on grape pomace and straw supstrate

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Oxidative stress caused by an imbalanced metabolism and an excess of reactive oxygen species (ROS) lead to a range of health disorders. Synthetic antioxidants can improve defence mechanisms, but their potential adverse toxic effects give priority to natural antioxidants. *Pleurotus ostreatus* (Jacq. ex Fr.) P. Kumer (1871) (oyster mushroom) is one of the most commonly cultivated mushrooms in the world due to its adaptibility to various substrates and having a specific mild taste of oyster in culinary processing. Because of the presence of various active ingredients it owns antidiabetic, antibacterial, anticholestrolic, antiarthritic, antioxidant, anticancer and antiviral activities.
The aim of this study was to monitor the influence of grape pomace supstrate on the antioxidative potential of oyster mushroom, as well as changes of antioxidant properties from the day of harvesting during the storage period of 7 and 14 days. The substrate used for cultivation of *Pleurotus ostreatus* was consisted of grape pomace and straw (20:80%) The fruiting bodies were air-dried at 55°C, powdered and then prepared as crude hot water extracts in mild conditions, at 75-85°C for 1.5 h. Concentration range of 0.625-40 mg/mL of each extract was analyzed. The radical absorbance ability of the extract was tested *in vitro*, using DPPH free radical and $ABTS^+$ radical scavenging capability and expressed as EC_{50} (mg/mL) values.
Crude water extracts showed the following results: EC_{50} values of the DPPH scavenging ability on the 0^{th}, 7^{th} and 14^{th} day were 30.25, 29.24 and 19.9 mg/mL, respectively. EC_{50} values of the $ABTS^+$ scavenging activity of the extracts on the 0^{th}, 7^{th} and 14^{th} day showed the difference, with following values: 8.1, 8.5 and 2.6 mg/mL, respectively. All investigated extracts showed good antioxidant abilities. Both methods confirmed decrease of the EC_{50} values and increasing of the antioxidative potential from harvesting day and during the storage period of 7 and 14 days.

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Aktivnosti peroksidaza u plodovima maline kao parametar ''funkcionalne hrane''

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Maline (*Rubus idaeus*), pored izvrsnog ukusa, privlače značajnu pažnju potrošača zbog visokog sadržaja različitih antioksidanasa. Njihova hemopreventivna svojstva se pripisuju širokom spektru fitohemikalija kao što su ugljeni hidrati, vitamini, minerali, dijetetska vlakna, a naročito u poslednje vreme, antioksidativni polifenoli. Međutim, studije enzimskih antioksidanata su vrlo ograničene u savremenoj literaturi. Među oksidazama, peroksidaze (*POD*) su ključni enzimi u procesu enzimskog „tamnjenja“ koji dovode do brze degradacije plodova, što drastično skraćuje njihov rok trajanja, naročito kod povređenih, oljuštenih ili obolelih voćnih tkiva prouzrokujući neželjene promene kvaliteta tokom rukovanja, obrade i skladištenja plodova. Cilj ove studije je bila ekstrakcija *POD* iz svežeg ploda maline, njihova delimična karakterizacija i ispitivanje intraspecijskih razlika u aktivnostima *POD* u smislu njihove upotrebe kao kriterijuma za selekciju. Iako su ukupne koncentracije proteina bile slične u plodovima dve različite sorte maline *'Autumn bliss'* i *'Polka'*, aktivnost *POD* je bila značajno veća kod sorte *'Polka'*, što je potvrđeno i izoelektričnim fokusiranjem gde su uočene dve ekstremne izoforme na različitim pI: kisela na 3.6 i bazna na 9.3. Kisele izoforme peroksidaza su suštinske u procesu lignifikacije, dok su bazne izoperoksidaze ekstracelularne ili uglavnom lokalizovane u vakuolama, odakle se lako mogu angažovati po potrebi. S obzirom na to da se maline karakterišu intenzivnim rastom i lignifikovanim organima, *POD* aktivnosti su od izuzetne važnosti sa oba aspekta: fiziološkog i nutritivnog. Promene aktivnosti enzima u vezi sa sadržajem supstrata igraju važnu ulogu u definisanju kvaliteta voća, što podrazumeva da sve ove promene zajednički doprinose kvalitetu finalnog proizvoda. Šire znanje o *POD* aktivnostima je imperativ za kontrolu i manipulaciju voćnih proizvoda nakon berbe, na putu do potrošača.

Profiling peroxidase activity of raspberry fruit-its association with the functional food

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Raspberries (*Rubus idaeus*), besides their exquisite flavor, have gained much attention by consumers due to their content of distinct antioxidants. Their chemopreventive properties are attributed to the wide range of phytochemicals such as carbohydrates, vitamins, minerals, dietary fibers and lately antioxidant polyphenols. However, studies of enzymatic antioxidants have been limited in contemporary literature. Among oxidases, peroxidases (POD) are key enzymes involved in the fast deterioration of fruits *via* browning process which drastically reduces their shelf-life especially in injured, peeled or diseased fruit tissues that can cause undesirable quality changes during handling, processing and storage of fruits. The purpose of the present study was the extraction of POD from fresh raspberry fruit tissues, their partial characterization and investigation of intraspecies differences in POD activities in terms of its utilization as a selection criterion. Although total protein concentrations were similar in two different raspberry cultivars ′Autumn bliss′ and ′Polka′, POD activity was much higher in ′Polka′, which was confirmed by isoelectric focusing with two distinguished isoforms visualized at different pI: the acidic at 3.6 and basic at 9.3. Acidic isoform is essential in the process of lignification, while basic isoperoxidases are extracellular or mainly localized in vacuoles from where they could be easily “engaged” as needed. Given that raspberries are characterized by intensive growth and lignifying organs as well, POD activity seems to be very important in both aspects: physiological and nutritional. Changes in enzyme activities related to the content of substrates play an important role in fruit’s quality definition, which implies that all of these changes jointly contribute to the quality of the final product. A wider knowledge of POD action is imperative to control and manipulate postharvest changes in fruit food products.

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Ljuska krompira kao potencijalni izvor prirodnih antioksidanasa

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Odlaganje otpada biljnog porekla nastalog preradom krompira je problem sa kojim se suočavaju fabrike za preradu krompira. S obzirom na to da odlaganje otpada izaziva štetne efekte po životnu sredinu, problem se može rešiti njegovim korišćenjem za stvaranje proizvoda sa dodatnom vrednošću. Naime, korišćenje ljuske krompira kao potencijalnog izvora prirodnih antioksidanasa može biti alternativa. Zbog toga je određen sadržaj ukupnih polifenola (TPC) i antioksidativna aktivnost (RSA) u uzorcima četiri sorte krompira (dve crvene - Laura i Red Fantasy i dve žute - Marabel i Jelly), uzgajanim u tri sistema gajenja (konvencionalnom, organskom, integralnom) u tri uzastopne godine (2013-2015). U metanolnim ekstraktima ljuske krompira TPC je određen spektrofotometrijski Folin-Ciocalteu-ovim postupkom, dok je 2,2-difenil-1-pikril hidrazil metod korišćen za određivanje antioksidativne aktivnosti. Statistički značajne korelacije između TPC i RSA u sve tri godine ukazuju na značaj fenola za antioksidativnu aktivnost ljuske krompira. Najviša srednja vrednost sadržaja TPC u ljuske krompira je dobijena za 2014. godinu i znatno je viša od vrednosti dobijenih za 2013. i 2015. Statistički značajna razlika u pogledu antioksidativne aktivnosti u uzorcima iz tri godine nije pronađena. Značajno niže vrednosti RSA su dobijene u uzorcima krompira uzgajanim u integralnom sistemu 2014. godine u poređenju sa organskim sistemom proizvodnje. Osim toga, značajna razlika u sadržaju TPC je pronađena između sorti proizvedenih 2014. i 2015. godine. Kod crvenih sorti, Red Fantasy i Laura, je konstatovan veći sadržaj fenola u odnosu na žute sorte Marabel i Jelly u sve tri godine. Rezultati pokazuju da bi ljuske krompira ovih sorti mogle biti vredan izvor fenolnih jedinjenja i potencijalno se mogu koristiti kao prirodni antioksidansi.

Potato peel as a potential source of natural antioxidants

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Disposal of potato processing waste and the pollution associated with it is a vital issue faced by the potato processing plants. Since the discharge of this waste causes detrimental effects to the environment, the problem can be resolved by using the waste for generating value-added products. Utilization of potato peels as a potential source of natural antioxidants may be an alternative. Therefore, the total phenolic content (TPC) and radical scavenging activity (RSA) were determined in potato peels of four different varieties (two red - Laura and Red Fantasy; and two yellow – Marabel and Jelly), cultivated in three different systems (Conventional, Organic, Integral) in three consecutive years (2013-2015). TPC in potato peel methanol extract was determined spectrophotometrically according to the Folin-Ciocalteu procedure, while 2,2-diphenyl-1-picryl hydrazyl method was used to examine the radical scavenging activity. Highly significant correlations between TPC and RSA in all three years indicate the importance of phenolics for antioxidant activity of potato peels. The highest mean value for TPC was obtained in 2014 year and was significantly higher than the values obtained in 2013 and 2015. There was no significant difference in potato peels' antioxidant activity between the three years. Significantly lower RSA values were obtained in potatoes cultivated in an integral type of production in 2014 as compared to the organic one. Moreover, a significant difference in TPC contents was found between varieties produced in 2014 and 2015. Higher contents of phenolics were identified in red varieties, Red Fantasy and Laura, than in the yellow varieties Marabel and Jelly, in all three years. These results show that potato peels of some varieties could be a valuable source of phenolic compounds and could potentially be used as a natural antioxidants.

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Ekstrakti ruzmarina kao moćni antioksidansi

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Ruzmarin (*Rosmarinus officinalis* L.), iz familije Lamiaceae, je široko korišćen u kulinarstvu i medicini zahvaljujući tome što sadrži etarsko ulje i različite polifenole, uključujući fenolne kiseline i flavonoide. Cilj ovog rada je da se uporedi sadržaj fenolnih kiselina (PAC), sadržaj flavonola (FLC) i ukupni redukcioni potencijal (TRP) ekstrakata listova ruzmarina gajenog u Beogradu (Srbija), Bogatiću (Srbija) i Lastvi Grbaljskoj (Crnogorsko primorje) sakupljenih u martu, julu i novembru. Sirovi ekstrakti dobijeni su pomoću 70% metanola, 70% etanola i vrele destilovane vode. Za svih 27 uzoraka je spektrofotometrijski određen PAC, FLC i antioksidativno dejstvo pomoću TRP testa pri koncentraciji od 0,5 mg/mL. Ekstrakti su pokazali širok opseg varijacija u PAC (21,22-211,96 mg CAE/g), FLC (0,80-5,73 µg QE/g) i TRP (486,03-1714,52 µmol AAE/g). Analiza ekstrakata metodom visokoefikasne tečne hromatografije sa spektrofotometrijskom detekcijom pokazala je veću zastupljenost ruzmarinske kiseline (RA) (3,14-113,74 mg/g) u poređenju sa hlorogenskom kiselinom (ChA) i kafenom kiselinom (CA) (<4 mg/g). U odnosu na stanište, uzorci iz Lastve su najbogatiji u sadržaju polifenola u svim testovima i pokazali najviši TRP, dok su uzorci iz Bogatića imali najniže vrednosti. Uzorci sakupljeni u martu su imali viši PAC i RA i ispoljili veći TRP, dok su vrednosti FLC veće u novembarskim i julskim uzorcima. Metanolni ekstrakti, za kojima slede etanolni ekstrakti, su bogatiji u PAC, FLC RA i ChA i pokazali snažnije antioksidativno dejstvo u TRP testu, dok su vodeni ekstrakti bogatiji u sadržaju CA. Prema tome, alkoholni ekstrakti uzoraka iz Lastve su pokazali najizrazitija antioksidativna svojstva u svim sezonama, što može biti pripisano sličnostima uslova gajenja i prirodnog staništa ruzmarina, kao i ujednačenosti sredinskih faktora tokom godine.

Rosemary extracts as potent antioxidant agents

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Rosemary (*Rosmarinus officinalis* L.), a member of the Lamiaceae family, is broadly exploited in cookery and medicine, since it contains the essential oil and different polyphenolics, including phenolic acids and flavonoids. The aim of this study was to compare phenolic acids content (PAC), flavonol content (FLC) and total reducing power (TRP) of rosemary leaves extracts obtained from plants cultivated in Belgrade (Serbia), Bogatić (Serbia) and Lastva Grbaljska (Montenegrian coast) collected in March, July and November. The crude extracts were obtained using 70% methanol, 70% ethanol and hot distilled water. All of 27 extracts were assessed spectrophotometrically at concentration of 0.5 mg/mL for PAC, FLC and for antioxidant activity using TRP assay. The extracts showed broad range of variations in PAC (21.22-211.96 mg CAE/g), FLC (0.80-5.73 µg QE/g) and TRP (486.03-1714.52 µmol AAE/g). Additionaly, HPLC-DAD analysis showed that rosmarinic acid (RA) was the most abundant (3.14-113.74 mg/g) comparing to chlorogenic (ChA) and caffeic acids (CA) (<4 mg/g). Regarding locality, samples from Lastva showed the highest contents of phenolics in all applied assays and the strongest TRP, while samples from Bogatić showed the lowest values. The samples harvested in March contained larger PAC and RA and exibited stronger TRP, while FLC was higher in samples collected in November and July. Methanolic extracts of all samples, followed by ethanolic ones, were richer in PAC, FLC, RA and ChA, and demonstrated higher antioxidant effect in TRP assay, comparing to water extracts which were richer in CA. Consequently, alcoholic extracts of Lastva samples had the most favorable antioxidant properties in all the harvesting seasons which could be attributted to similarities of environmental conditions of cultivation and native habitats of rosemary as well as to uniformity of environmental factors during the year.

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Određivanje sadržaja fluorida u alkoholnim pićima potenciometrijskom metodom

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Potenciometrijska analiza kao potencijalni metod za određivanje koncentracije fluorida pokazala se veoma jednostavnom, pouzdanom i veoma jeftinom. Vrlo male koncentracije fluoridnih jona (do 10^{-7} mol/L) se mogu detektovati pomoću jon selektivne fluoridne elektrode (ISE). Prilikom korištenja fluoridne elektrode veoma je važno voditi računa o jonskoj jačini rastvora, kao i kontrolisati koncentracije hidroksilnih jona i interferencije jona metala. Uticaj pH i kompleksiranje jona metala se uspješno reguliše TISAB puferom i održavanjem pH vrijednosti između 5,0 i 5,5. Fuoridna jedinjenja se koriste u prevenciji bolesti zuba i mogućih sporednih dejstava, prvenstveno fluoroze zuba. Zbog toga istraživanja koja se odnose na ispitivanje sadržaja fluorida u svakodnevnoj hrani, uključujući alkoholna pića, su veoma bitna. Naročito je značajan nivo fluorida u lokalnim vodovodima koji se odražava na proizvode dobijene upotrebom te vode. Prema preporukama Svjetske zdravstvene organizacije, unos fluorida bi se trebao ograničiti na 2 do 4 mg na dan, i neophodno je da se naznači sadržaj fluorida na svim proizvodima koji se koriste u ljudskoj ishrani.
Cilj ovog ispitivanja je da se utvrdi sadržaj fluorida u vinima i pivima koji su potencijalni izvor fluorida. Uzorci alkoholnih pića su uzeti sa tržišta Republike Srpske, i imali su različit sadržaj etanola u sebi. Dvadeset uzoraka uzetih u prodavnicama u Banjaluci analizirano je pomoću fluoridne elektrode. Polovina uzoraka su bili piva, a preostalih deset se su bili uzorci vina, uključujući i crvena i bijela vina. Pored toga, izvedena je analiza uzorka vode iz gradskog vodovoda Banja Luka.
Svi analizirani uzorci zadovoljavaju kriterijume o količini fluorida propisane Pravilnikom o zdravstvenoj ispravnosti vode za piće, po kome je dozvoljena koncentracija fluorida u vodama za piće 1,5 mg/L. Određena koncentracija fluorida u analiziranim uzorcima vina se kreće u opsegu od 0,04 do 0,7 mg/L, a u uzorcima piva od 0,02 do 0,3 mg/L. Koncentracije fluorida u analiziranim uzorcima su niže od 1,5 mg/L, što zadovoljava propise o dozvoljenim koncentracijama fluorida.
Ključne riječi: fluoridi, fluoridni joni, alkoholna pića, potenciometrijska analiza, jon selektivna fluoridna elektroda

Determination of fluoride in alcoholic beverages by potentiometric method

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Potentiometric method as a method for determination of fluoride ions proved to be very simple, reliable and quite cheap. Very small concentrations of fluoride ions (up to 10^{-7} mol/L) can be determined by fluoride selective electrode (ISE). By using the fluoride ISE it is important to control ionic strength of a solution and to control the concentration of hydroxide ions and interfering ions of metals. The influence of pH and complexing ions of metals was successfully regulated by the TISAB buffer solution and by preserving pH value in the range from 5,0 to 5,5. Fluoride compounds are used in the prevention of tooth diseases and possible ancillary effects, primarily fluorosis of the teeth. Therefore, the research of fluoride content in everyday food, including alcoholic beverages, seems to be very important. Particularly significant is the level of fluoride in local waterways, which is reflected on the products obtained by the use of this water. According to World Health Organization recommendation (WHO), uptake of fluorides should be limited in the range from 2 to 4 mg per day, and it is necessary to give the content of fluorides on all products that are used in humans consumption.
The aim of this study was to determine the fluoride content in wines and beers, which are potential source of fluoride. The alcoholic drinks were taken from Republika Srpska market, and were different in terms of the percentage content of ethanol. Twenty samples of alcoholic beverages, derived from retail objects in Banja Luka, were analyzed. Half of the avalilable samples were beers and the rest were wines, of which, both, red and white wines were included. Additionaly, the fluoride content was also determined in tap water.
All the analyzed samples meet the criteria for the fluoride quantity prescribed by the Ordinance on Drinking Water Health, by which the fluoride concentration in drinking water is 1.5 mg / L. It was determined that the content of fluoride ions in wine is 0,04-0,7 mg/L, and beer 0,02-0,3 mg/L. Fluoride concentrations in the analyzed samples are below 1.5 mg/L which meets the permissible fluoride concentration limits.
Keywords: fluoride, fluoride ions, alcoholic beverage, potentiometric analysis, ion selective fluoride electrode

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Antioksidativne osobine etanolnih ekstrakata *Rubus caesius* L.

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Rubus caesius L. (fam: Rosaceae) je vrsta grma poznata po plodovima - divljim kupinama. Nadzemni delovi *R. caesius* sadrže koncentrovane vredne nutrijente i bioaktivne komponente od terapeutskog značaja (različite vitamine, steroide i lipide iz semena - orašica, minerala, flavonoida, glukozida, terpena, fenolnih kiselina i tanina). U Srbiji, divlje rastuće vrste kupina upotrebljavaju se kao sveži plodovi, sokovi ili džemovi. U srpskoj tradicionalnoj medicini, listovi kupine se koriste u terapiji dijabetesa i dijareje. Brojni literaturni podaci o različitim vrstama kupina, pokazuju raznovrsne farmakološke aktivnosti: antioksidativne, antikancerogene, antiinflamatorne, antimikrobne i antiviralne... Naš rad odnosi se na ispitivanje mogućnosti hvatanja slobodnih radikala i mogućnosti heliranja metalnih jona iz etanolnih ekstrakata različitih organa vrste *R. caesius*. Ispitivani su etanolni ekstrakti stabla, listova i plodova da bi se utvrdio sadržaj fenola i flavonoida. Antioksidatvne sposobnosti ekstrakata testirane su metodama DPPH, ABTS i FRAP. Sadržaj fenola u ekstraktima determinisan je korišćenjem Folin-Ciocalteu reagensa. Dobijene su vrednosti 35.8-235.05 mgGAE/g. Najveća količina fenola konstatovana je u ektraktu lista. Sadržaj flavonoida meren je korišćenjem aluminijum nitrata nonahidrata i vrednosti su varirale od 4.61mgQu/g u plodu, do 28.95 mgQu/g u lisnom ekstraktu. Upotrebom DPPH testa dokazano je da je ekstrakt stabla pokazao najveću aktivnost u hvatanju slobodnih radikala (IC_{50}= 0.096mg/mL). Etanolni ekstrakt stabla pokazao je, takođe, najveću aktivnost i upotrebom ABTS testa (IC_{50}= 0.203 mg/mL). Visoku sposobnost redukcije u FRAP testu, pokazao je, ponovo ekstrakt stabla (2.64 μM Fe/g). Ekstrakti plodova pokazali su najslabiju antioksidativnu aktivnost u svim primenjenim testovima. Najveća količina fenola i flavonoida izmerena je u listovima, dok je najveći antioksidativni kapacitet pokazao, neočekivano, ekstrakt stabla *R. caesius.*

Antioxidant properties of *Rubus caesius* L. ethanol extracts

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Rubus caesius L. (Rosaceaea) is a shrub famous for its fruit called blackberry. Aerial parts of *R. caesius* contain concentrated source of valuable nutrients, as well as bioactive constituents of therapeutic interest (different vitamins, steroids and lipids in seed oil, minerals, flavonoids, glycosides, terpenes, phenol acids and tannins). In Serbia, wild growing *R. caesius* as a fresh fruit, juices and jams is often used as tasty food. In tradicional medicine dry leaves in form of herbal tea are effective in the treatment of diabettes and diarrhea. Literature data showed diverse pharmacological activities such as antioxidant, anti-carcinogenic, anti-inflammatory, antimicrobial and antiviral activity of *Rubus* spp. Our research focuses on the free radical scavenging and metal chelating activity of different plant parts of *R. caesius*. The ethanol extracts of stem, leaf and fruit were examined for their total phenol and flavonoid content (TPC, TFC) while antioxidant properties of these extracts was determined using DPPH, ABTS and FRAP assays. The total phenol content in the extracts was determined using Folin-Ciocalteu reagent and their amounts ranged between 35.80 to 235.15 mg GAE/g. The highest phenol amount was found in leaf extract. Total flavonoids were measured using aluminium nitrate nonahydrate where their concentration varied from 4.61 for fruit to 28.95 mg Qu/g for leaf extract. In DPPH test, extract of stem was found with the highest activity (IC_{50} = 0.096 mg/mL). Also, this extract showed the best free radical scavenging potential in ABTS assay (IC_{50} = 0.203 mg/mL). The most potent reducing power in FRAP test was stem extract (2.64 μM Fe/g). Fruit extract of *R. caesius* was the weakest in all measurments, while the largest amount of phenol, flavonoids and the strongest antioxidant capacity was shown for stem extract, which was rather unexpected.

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Hemijski sastav lišća jabuke u zavisnosti od ekspozicije svetlosti

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Hemijska karakterizacija gajenih kultura, kao jabuke (*Malus domestica* Borkh.), može da bude korisna u razvoju novih sorti i inovacijama u poljoprivrednoj praksi. Cilj ovog rada je ispitivanje sadržaja šećera i polifenola u lišću jabuke sorti Greni Smit i Zlatni Delišes na različitim pozicijama drveta, zavisno od stepena osvetljenosti i udaljenosti lista od ploda. Ispitivana stabla su podeljena u dve grupe, pri čemu je jedna grupa bila zasenčena mrežom. Sadržaj šećera je određen jonskom hromatografijom sa elektrohemijskim detekcijom (*HPAEC/PAD*), a sadržaj polifenola je analiziran tečnom hromatografijom sa masenim detekcijom (*UHPLC-MS/MS*). Koncentracija floretina i kvercetina u uzorcima prikupljenim u gornjem delu krošnje bila je veća nego u donjem, nezavisno od zasenčenosti mrežom, kod obe sorte. Kod sorte Greni Smit, koncentracija glukoze i sorbitola u uzorcima lišća stabala koja nisu pokrivena mrežom je takođe veća u uzorcima iz gornjeg dela krošnje, međutim pod mrežom trend je suprotan.

Chemical Composition of Apple Leaves Depending on Light Exposure

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Chemical characterisation of cultivated plants, like apple (*Malus domestica* Borkh.) can be useful in the development of new cultivars and innovation in agricultural practice. The aim of this study is examination of differences in polyphenol and sugar content in apple leaves (*Granny Smith* and *Golden Delicious* cultivars) correlated to different positions on tree, their different exposure to light and source-sink distance. Trees were divided into two groups; one was shaded with a net. Sugar content was determined by ion chromatography with electrochemical detection (HPAEC-PAD). Polyphenol content was determined with liquid chromatography mass spectrometry detection (UHPLC–DAD MS/MS). Phloretin and quercetin concentrations in the samples collected in upper part of tree were higher than in the leaves collected in lower part, independently of shading and analysed cultivar. Glucose and sorbitol content in *Granny Smith* cultivar of trees which weren't shaded, was also higher in leaves from the upper part, unlike in the samples from shaded trees where the concentrations were higher in the leaves obtained from the lower part of tree.

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BKHP33 / FQSP33

Uticaj etarskog ulja i etanolnih ekstrakata bosiljka (*Ocimum basilicum* L.) na oksidativnu stabilnost hladno presovanog suncokretovog ulja u uslovima ubrzanog starenja

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U ovom radu je ispitano povećanje oksidativne stabilnosti hladno presovanog suncokretovog ulja (HPSU) primenom etarskog ulja i etanolnih ekstrakata bosiljka (*Ocimum basilicum* L.). Uzorci HPSU sa različitim koncentracijama etarskog ulja i ekstrakata (250, 500 i 1000 ppm), kao i kontrolni uzorci- $HPSU_{BHT}$ sa dodatkom sintetičkog antioksidansa BHT u količini od 250 ppm, i uzorak bez dodataka ($HPSU_0$), su ispitani primenom Shaal-Oven testa, na temperaturi od 63±2°C u toku 12 dana. U intervalima od 4 dana, ispitivani su peroksidni broj, anisidinski broj i konjugovani dieni i trieni, kako bi se stekao uvid u stepen nastalih oksidativnih promena. Takođe, određen je i indukcioni period (IP) uzoraka Rancimat metodom na temperaturi od 100°C. Svi uzorci su imali bolju održivost u odnosu na $HPSU_0$ (IP=7.42h) ali niže vrednosti u odnosu na $HPSU_{BHT}$ (IP=9.26h).
GC-FID i GC-MS analizom etarskog ulja je utvrđeno da su linalol (40.97%), 1-epi-bicikloseskvifelandren (8.70%) i metil kavikol (7.92%) glavne komponente etarskog ulja bosiljka. Ekstrakti bosiljka su dobijeni ekstrakcijom po Soxhletu (BE_{SE}) i maceracijom pomoću ultrazvuka (BE_{UAM}) pri čemu je kao rastvarač korišćen 70% etanol. LC/MS analizom je ispitan polifenolni sastav ekstrakata. Rutin i kvercetin su bili najzastupljeniji flavonoidi, dok je od fenolnih kiselina glavni predstavnik u oba ekstrakta bila kefeinska kiselina. Elaginska kiselina je detektovana samo u BE_{UAM}. U ekstraktima je određen i ukupan sadržaj fenola i flavonoida. Za ispitivanje antioksidativne aktivnosti etarskog ulja i ekstrakata primenjeni su testovi DPPH, FRAP i β-karoten/linolna kiselina. Ekstrakti su pokazali znatno jaču aktivnost od etarskog ulja u svim testovima dok se u FRAP testu BE_{SE} pokazao kao znatno efikasniji u odnosu na BE_{UAM}. Dobijeni rezultati potvrđuju da se bosiljak može koristiti za odlaganje oksidativnih promena u HPSU i da su etanolni ekstrakti bosiljka efikasniji kao prirodni antioksidansi u odnosu na etarsko ulje.

Effect of basil (*Ocimum basilicum* L.) essential oil and ethanolic extracts on the oxidative stability of cold-pressed sunflower oil in accelerated storage conditions

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The aim of this study was to enhance the oxidative stability of cold pressed sunflower oil (CPSO) by using essential oil and ethanolic extracts of basil (*Ocimum basilicum* L.). Samples of CPSO with various concentration of essential oil and extracts (250, 500 and 1000 ppm), as well as control samples- $CPSO_{BHT}$ with addition of synthetic antioxidant BHT in the amount of 250 ppm and sample without additives ($CPSO_0$), were tested using the Shaal-Oven test. Samples were exposed to temperature of 63±2°C for 12 days. In order to determine a level of oxidative changes, samples were analyzed for peroxide value, anisidine value and conjugated dienes and trienes every 4 days. Induction period (IP) of samples by the Rancimat method was determined at the temperature of 100°C. All tested samples had better sustainability compared to $CPSO_0$ (IP=7.42h) but lower than $CPSO_{BHT}$ (IP=9.26h).
Essential oil was analysed by GC-FID and GC-MS techniques. As the main identified compounds were identified linalool (40.97%), 1-epi-bicyclosesquephelandrene (8.70%) and methyl chavicol (7.92%). Basil extracts were obtained by Soxhlet extraction procedure (BE_{SE}) and ultrasound-assisted maceration (BE_{UAM}), using 70% ethanol as extraction solvent. Polyphenolic profile of extracts was established using LC/MS technique. Rutin and quercetin were the most abundant flavonoids while caffeic acid was the main phenolic acid present in both extracts. Ellagic acid was detected only in BE_{UAM}. The content of phenols and flavonoids was also investigated. Antioxidant activity of essential oil and extracts was evaluated by DPPH, FRAP and β-carotene bleaching assays. In all assays, extracts showed stronger activity compared to essential oil. In FRAP test, BE_{SE} has sighificantly higher activity in comparison with BE_{UAM}. The obtained results confirmed that basil can be used for delaying oxidative changes in CPSO. Additionally, results indicate that basil ethanolic extracts are more effective antioxidants compared to essential oil.

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BKHP34 / FQSP34

Određivanje ^{137}Cs u pečurkama

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^{137}Cs je antropogeni radionuklid, fisioni produkt sa vremenom poluraspada od 30 godina. Ovaj radioizotop je dospeo u životnu sredinu nakon nadzemnih nuklearnih proba šezdesetih godina prošlog veka i nakon akcidenta u Černobilju 1986. godine. Cilj ovog rada je ispitivanje ^{137}Cs u pečurkama. Poznato je da pečurke imaju osobinu da akumuliraju teške metale kao i radionuklide i koriste se kao bioindikatori za procenu radijacionog opterećenja stanovništva. Koncentracija ^{137}Cs u pečurkama zavisi od vrste pečurke, ali i od načina obrade (sušenje, mariniranje). U toku 2016. i 2017. god. u Laboratoriji za zaštitu od zračenja i zaštitu životne sredine, Institut Vinča, ispitano je ukupno 81 uzoraka pečuraka i to 35 uzoraka vrganja (24 svežih i 11 suvih), 42 uzoraka lisičarki (39 svežih i 3 suve) i 4 uzoraka tartufa. Svi uzorci su analizirani spektormetrijom gama emitera na HPGe detektorima. Date pečurke su deo radioekoloških ispitivanja šumskih ekosistema. Rezultati koji su dobijeni pokazuju vrednosti ^{137}Cs u opsegu <0.6-84 Bq/kg za sveže vrganje, <5-180 Bq/kg za suve vrganje, <1-19 Bq/kg za sveže lisičarke, <4-360 Bq/kg za suve vrganje i <1 Bq/kg za tartufe. Granica sadržaja ^{137}Cs u svežim pečurkama je 150 Bq/kg, dok je u suvim pečurkama 600 Bq/kg (Pravilnik o granicama sadržajama radionuklida u vodi za piće, životnim namirnicama, stočnoj hrani, lekovima, predmetima opšte upotrebe, građevinskom materijalu i drugoj robi koja se stavlja u promet Sl. Glasnik RS 36/18). Svi rezultati dobijene za analizirane uzorke zadovoljavaju Pravilnikom propisane vrednosti. Može se zaključiti da je koncentracija u suvim pečurkama veća nego u svežim.

^{137}Cs in mushrooms

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^{137}Cs is an anthropogenic radionuclide, a fission product with a half-life of 30 years. This radioisotope came into the environment after the above-ground nuclear tests in the 1960s and after the accident in Chernobyl in 1986. The aim of this paper is to examine concentration of ^{137}Cs in mushrooms. It is known that mushrooms have the ability to accumulate heavy metals as well as radionuclides and are used as bioindicators to assess the population's radiation burden. The concentration of ^{137}Cs in mushrooms depends on the type of mushroom, but also on the treatment (drying, marinating). During 2016 and 2017. in the Radiation and Environmental Protection Department, Institute Vinča, a total of 81 mushrooms samples were examined: 35 *Boletus edulis* samples (24 fresh and 11 dry), 42 *Cantharellus cibarius* samples (39 fresh and 3 dry), and 4 *Truffles samples*. All samples were analyzed by gamma spectrometry on HPGe detectors. These mushrooms are part of the radioecological examination of forest ecosystems. The results obtained show values of ^{137}Cs in the range <0.6-84 Bq/kg for fresh *Boletus edulis*, <5-180 Bq/kg for dry *Boletus edulis*, <1-19 Bq/kg for fresh *Cantharellus cibarius*, <4-360 Bq/kg for dry *Cantharellus cibarius* and <1 Bq/kg for *Truffles*. The limit of ^{137}Cs content in fresh mushrooms is 150 Bq/kg, while in dry mushrooms is 600 Bq/kg (Official Gazette RS 36/18 Rulebook on limits of radionuclides content in drinking water, food stuffs, feeding stuffs, medicines, products for general use, construction materials and other goods that are put on market). Results obtained for the analyzed samples met the limits given in the Rulebook. It can be concluded that the concentration in dry mushrooms is higher than in fresh mushrooms.

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BKHP35 / FQSP35

Novi uvid u fitohemijski profil, antioksidativne osobine i biokompatibilnost metanolnog ekstrakta nadzemnog dela biljke *Salvia verticillata* L.

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Rod *Salvia* je najbrojniji rod u familiji Lamiaceae i sastoji se od skoro 1000 biljnih vrsta rasprostranjenih širom sveta. Vrste roda *Salvia* su aromatične biljke koje se koriste u kulinarstvu kao začini i čajevi, ali i u kozmetičkoj industriji i u tradicionalnoj medicini, zahvaljujući njihovim raznovrsnim bioaktivnim svojstvima. *Salvia verticillata* L. je višegodišnja zeljasta biljka sa sitnim ljubičastim cvetovima grupisanim u pršljenove. Postoje podaci da je ova vrsta korišćena pri pravljenju sira specifičnog ukusa. U srpskoj tradicionaloj medicini koristi se čaj od nadzemnih delova *S. verticilata* kao ekspektorant, za dezinfekciju usne duplje i kao oblog za zarastanje rana.

Cilj ovog istraživanja bilo je dobijanje fitohemijskog profila metanolnog ekstrakta nadzemnog dela biljke *S. verticillata*, i evaluacija antioksidativnog potencijala (na DPPH, ABTS i NO radikale, ukupan antioksidativni kapacitet i inhibicija lipidne oksidacije) uz ispitivanje biokompatibilnosti (korišćenjem BalbC-3T3, HaCaT, A431, HepG2 i LoVo ćelijskih linija). Jedinjenja karakteristična za ovaj rod, kao što su ruzmarinska i kafeinska kiselina, njihovi derivati (izomeri salvianolične kiseline) i flavonoidi identifikovani su pomoću UHPLC–MS^4 Orbitrap analize kao glavna polifenolna jedinjenja u nadzemnom delu *S. verticillata*. Ekstrakt je pokazao značajan antioksidativni potencijal, posebno antiradikalski efekat sa IC_{50} vrednostima u rangu od 33-73 µg/mL. Nisu zapažene značajne razlike u procentu preživljavanja ćelija između kontrolne grupe i grupa tretiranih ekstraktom nakon 48 i 72 h, što ukazuje da je ekstrakt potpuno biokompatibilan sa normalnim ćelijama i bez citotoksičnih efekata na ćelijskim linijama raka.

Uzimajući u obzir navedene rezultate, prisustvo bioaktivnih polifenolnih jedinjenja, obećavajući antioksidativni potencijal i biokompatibilnost, može se izvesti zaključak da biljka *S. verticillata* može naći nove vidove primene kao sastojak hrane i izvor nutraceutika sa istaknutim lekovitim osobinama.

New insights into the phytochemical profile, antioxidant properties and biocompatibility of *Salvia verticillata* L. aerial parts methanol extract

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The genus *Salvia* is the largest genus in Lamiaceae family, comprising nearly 1000 plant species distributed worldwide. The *Salvia* species are aromatic plants used as culinary herbs, spices, tea, in cosmetic industries and in traditional medicine because of their diverse bioactive properties. *Salvia verticillata* L. is a herbaceous perennial herb with tiny lavender flowers which grow tightly packed in whorls. This plant is used in the cheese making process to obtain specific taste. In traditional Serbian medicine *S. verticilata* tea, made from its aerial parts, has been used as expectorant, for disinfection of the oral cavity and as cataplasm for healing wounds.

The aim of the study was to acquire phytochemical profile of *S. verticillata* aerial parts methanol extract, and to evaluate its antioxidant potential (DPPH, ABTS and NO radicals, total antioxidant capacity and inhibition of lipid oxidation) along with biocompatibility (using BalbC-3T3, HaCaT, A431, HepG2 and LoVo cell lines). Characteristic compounds of the genus *Salvia*, such as rosmarinic and caffeic acids, their derivatives (e.g. salvianolic acid isomers) and flavonoids, have been identified by UHPLC–MS^4 Orbitrap metabolic fingerprinting as the main polyphenolic compounds in *S. verticillata* aerial parts. The extract displayed significant antioxidant potential, exceptionally antiradical effects with IC_{50} values ranging from 33-73 µg/mL. No significant differences in cell survival between control group and groups treated with the extract were observed, so the extract showed total biocompatibility with the normal cell lines after 48 and 72 h and no cytotoxic effects on cancer cell lines.

The obtained results have revealed the presence of polyphenolic bioactive compounds in *S. verticillata* extract with promising antioxidant potential and significant biocompatibility. In this regard, the *S. verticillata* can find new perspectives of application as food ingridient and source of nutraceuticals with prominent health properties.

Antioksidativna aktivnost odbrambenih sekreta stonoga *Pachyiulus hungaricus* (Karsch, 1881) i *Megaphyllum unilineatum* (C. L. Koch, 1838) (Diplopoda, Julida, Julidae)

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Upotreba stonoga kao medicinskih sredstava ili hrane je zabeležena u nekoliko različitih kultura čime su postale prepoznatljive kao potencijalni resurs za ljude. Do sada je širok spektar biološki aktivnih jedinjenja izolovan iz stonoga a naročito iz njihovih odbrambenih sekreta, a pojedina jedinjenja se mogu smatrati potencijalno jakim antioksidansima. Cilj ovog istraživanja je bila procena antioksidativnog kapaciteta etanolnog, metanolnog, heksanskog i dihlormetanskog ekstrakta dve široko rasprostranjene vrste stonoga, *Pachyiulus hungaricus* i *Megaphyllum unilineatum*. Antioksidativna aktivnost odbrambenih sekreta je određivana korišćenjem ABTS, DPPH i testa totalnog redukcionog potencijala. Testirani ekstrakti su pokazali snažan antioksidativni potencijal čiji je intenzitet varirao u zavisnosti od rastvarača korišćenog za ekstrakciju. Ekstrakti *P. hungaricus* su imali jaču antioksidativnu aktivnost u poređenju sa ekstraktima *M. unilineatum*. Najveći antioksidativni kapacitet je zabeležen za metanolni ekstrakt *P. hungaricus* kako ABTS (0,972 ± 0,036 mg/mL) tako i DPPH (0,114 ± 0,002 mg/mL) testom. EC_{50} vrednost L-askorbinske kiseline je bila 0,263 ± 0,011 mg/mL odnosno 0,041 ± 0,002 mg/mL (određena putem ABTS, odnosno DPPH testa) Najslabija antioksidativna aktivnost je zabeležena za metanolni ekstrakt *M. unilineatum* u oba testa (5,439 ± 0,441 mg/mL, odnosno 3,451 ± 0,184 mg/mL). Isti trend je bio karakterističan i u testu totalnog redukcionog kapaciteta, sa maksimalnom redukcionom snagom u metanolnom ekstraktu *P. hungaricus* (1,003 ± 0,036 mg AAE/mg suvog ekstrakta) što predstavlja aktivnost koja je približno jednaka L-askorbinskoj kiselini. Izražena antioksidativna aktivnost najverovatnije je posledica prisustva hidrohinona, *p*-benzohinona kao i hidroksil derivata *p*-benzohinona koji su poznati kao jaki antioksidansi. Takođe, veći intenzitet neutralizacije slobodnih radikala ekstrakata *P. hungaricus* se može dovesti u vezu sa većim udelom alkil estara karboksilnih kiselina sa dugim lancem.

Antioxidative activity of defensive secretions of *Pachyiulus hungaricus* (Karsch, 1881) and *Megaphyllum unilineatum* (C. L. Koch, 1838) (Diplopoda, Julida, Julidae)

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In several cultures millipedes have been used as medical remedies or food items and are recognized as a promising resource for humans. So far, a wide spectrum of biologically active compounds has been identified from millipedes, especially their defensive secretions, and some of them can be considered as potentially strong antioxidants. The aim of the study was to evaluate antioxidative potential of ethanol, methanol, hexane and dichloromethane extracts of two widely distributed millipede species, *Pachyiulus hungaricus* and *Megaphyllum unilineatum*. Antioxidative activities of defensive secretion extracts were determined by ABTS, DPPH and total reducing power tests. Tested extracts showed strong antioxidative potentials which varied depending on solvent used for the extraction or applied assay. Generally, extracts of *P. hungaricus* exhibited stronger antioxidative activity in comparison with *M. unilineatum* defensive secretion. The highest antioxidative capacities were noticed for MetOH extract of *P. hungaricus* defensive secretions, in both ABTS assay (0.972 ± 0.036 mg/mL) and in DPPH assay (0.114 ± 0.002 mg/mL). EC_{50} values of L-ascorbic acid were 0.263 ± 0.011 mg/mL and 0.041 ± 0.002 mg/mL, in ABTS and DPPH test, respectively. At the same time the lowest antioxidative activity was observed for MetOH extracts of *M. unilineatum* secretions in both assays (5.439 ± 0.441 mg/mL and 3.451 ± 0.184 mg/mL, respectively). The same trend characterized reducing power capacity with the maximum reducing power of MetOH extract of *P. hungaricus* (1.003 ± 0.036 mg AAE/mg of dried extract) which was comparable with L-ascorbic acid. Strong antioxidative activity is probably the result of the presence of hydroquinone, *p*-benzoquinone, as well as hydroxyl derivatives of *p*-benzoquinone which are known as potent antioxidants. Also, higher scavenging ability of *P. hungaricus* extracts can be correlated with the higher proportion of alkyl esters of long chain carboxylic acids.

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BKHP37 / FQSP37

Hemijski sastav i biološka aktivnost odabranih italijanskih vina

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U ovom radu ispitivan je hemijski sastav i biološka aktivnost tri odabrana uzorka vina (*Merlot*, *Morcinaia* i *Sangiovese*) poreklom iz Republike Italije. Konkretno, spektrofotometrijski, određeni su sadržaj ukupnih fenola i antocijana, dok su pojedinačni polifenoli (uključujući antocijane) kvantifikovani pomoću pomoću ultra-efikasne tečne hromatografije sa masenim detektorom visoke rezolucije. U nedostatku standarda, pojedini derivati antocijana okarakterisani su na osnovu tačne mase molekulskog jona (M^+) i njegove fragmentacije. Konačno, u uslovima *in vitro*, spektrofotometrijski određena je anti-DPPH radikalska aktivnost datih uzoraka crvenih vina.

Chemical composition and biological activity of selected Italian wines

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This study was focused on the chemical composition and biological activity of three selected red wine samples (*Merlot*, *Morcinaia* and *Sangiovese*) originated from the Republic of Italy. While total contents of phenolics and anthocyanins were determinated by UV-VIS spectrophotometry, single phenolic compounds (including anthocyanins) were quantified using ultra high performance liquid chromatography with a high resolution mass spectrometry detector. In the abscence of relevant analytical standards, some derivatives of anthocyanin compounds were characterised by the exact mass of molecular ion peak (M^+) and its fragmentation. Finally, anti-DPPH radical activity was estimated using a well known spectrophotometric assay at *in vitro* conditions.

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BKHP38 / FQSP38

Садржај полифенола и антиоксидативна активност воћних чајева

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Воћни чајеви су мешавине биљних чајева који садрже најмање 50% уситњених сувих делова дивљег или гајеног воћа. Због антиоксидативних својстава воћа, као и пријатног мириса и укуса, конзумирање воћних чајева је у сталном порасту.
Циљ рада је био анализа полифенолног састава и антиоксидативних својстава инфуза одабраних трговачких узорака различитих врста воћних чајева, од којих су припремљени инфузи према упутствима произвођача. Садржај укупних полифенола и укупних флавоноида одређен је спектрофотометријски. Присуство појединачних полифенолних једињења анализирано је применом *HPLC* методе. Процена антиоксидативног потенцијала припремљених инфуза воћних чајева извршена је на основу резултата *ABTS, DPPH* и *FRAP* анализе, поређењем вредности антиоксидативног композитног индекса (*ACI*), одређеног рачунским путем. Садржај укупних полифенолних једињења анализираних инфуза воћних чајева је био у распону од 2,35 до 59,74 mg *GAE*/100 mL, док је садржај укупних флавоноида био од 5,42 до 585,95 mg *CE*/100 mL. У зависности од врсте воћног чаја, утврђено је присуство различитих полифенолних једињења, попут хлорогенске киселине, изокверцитрина, хетерозида кверцетина и флавоноидних хетерозида. У погледу антиоксидативног потенцијала, највећа вредност *ACI* утврђена је за инфуз плода шипурка (96,1%), затим следе плод ароније (62,7%), комбинација плода шипурка и цвета хибискуса (51,6%), док је најмања вредност добијена за инфуз припремљен од сушених плодова нонија (35,7%). На основу добијених резултата може се закључити да воћни чајеви представљају значајан извор полифенолних једињења. Врста плода и начин припреме имају значајан утицај на антиоксидативна својства и садржај најважнијих једињења у инфузима воћних чајева.

The phenolic content and antioxidant activity of fruit teas

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Fruit teas are herbal tea mixtures containing at least 50% of crushed dry parts from wild or cultivated fruits. Due to the antioxidant properties, pleasant smell and taste, fruit teas consumption is raising.
The aim was to analyse polyphenol content and antioxidant properties of selected commercial samples of fruit teas infusion, prepared according to the manufacturer's instructions. The content of total phenolic compounds and total flavonoids was determined by spectrophotometry. Individual phenolic compounds were identified using HPLC method. Antioxidant potential of prepared fruit teas infusions was evaluated by comparison of the values of calculated antioxidant composite index (ACI) based on the results of ABTS, DPPH and FRAP analysis.
The content of total phenolic was in a range from 2.35 to 59.74 mg GAE/100 mL, while the content of total flavonoids was from 5.42 to 585.95 mg CE/100 mL. Depending on the fruit tea type, the presence of various phenolic compounds was determined, such as chlorogenic acid, isoquercitrin, quercetin glycoside and flavonoid glycoside. In terms of antioxidant potential, the greatest value of ACI was determined for rose-hips infusion (96.1%), followed by the fruit of aronia (62.7%), a combination of fruit of rose-hips and hibiscus flower (51.6%), while the lowest value was obtained for infusion prepared from dried noni fruit (35.7%).
Based on these results it can be concluded that fruit teas are a significant source of phenolic compounds. Types of fruit and methods of preparation have the significant impact on the antioxidant properties and content of most important compounds in fruit teas infusions.

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BKHP39 / FQSP39

Prasium majus L. iz Libije kao prirodni izvor antioksidanasa

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Prasium majus L. (Lamiaceae) je aromatični grm poznat pod narodnim nazivom slanovitac. To je polimorfna vrsta koja kao samonikla raste u Mediteranskom regionu Evrope, Severne Afrike i Srednjeg Istoka. Ova biljka se često koristi u tradicionalnoj kuhinji južnog Mediterana. U lekovite svrhe se primenjuje za lečenje gastrointestinalnih tegoba. Cilj ovog istraživanja je bio spektrofotometrijsko određivanje ukupnog sadržaja fenola i flavonoida, kao i merenje antioksidativnog potencijala uzoraka *P. majus* iz Libije radi pronalaženja novih, potencijalnih prirodnih antioksidanasa. Nadzemni delovi biljke u cvetu su ekstrahovani pomoću različitih rastvarača (metanol, etanol, etil-acetat i voda) metodom ultrazvučne ekstrakcije. Merena je ukupna količina fenolnih jedinjenja u ekstraktima i izvršena je procena njihovog antioksidativnog potencijala upotrebom DPPH i ABTS testova. U metanolnom ekstraktu (c=1 mg/mL) je izmeren najveći sadržaj fenola (97.833 ± 0.015 mg GKE/g suvog ekstrakta (SE), a prema rezultatima ABTS testa, ovaj ekstrakt je pokazao i najbolju antioksidativnu aktivnost (0.791 ± 0.003 mg vit. CE/g SE). Najbogatiji flavonoidima bio je etil-acetatni ekstrakt (79.077 ± 0.066 mg KHE/g SE), koji je imao i visok potencijal u neutralisanju radikala u ABTS testu (0.674 ± 0.012 mg vit. CE/g SE). Svi testirani uzorci su ispoljili nižu aktivnost u odnosu na kvercetin hidrat (2.75 ± 0,000 mg vit. CE/g SE). Kao najefikasniji agens u DPPH metodi pokazao se vodeni ekstrakt (IC_{50} = 3.66 ± 0.01 mg/mL), gde je izmerena i značajna koncentracija fenola (84.979 ± 0.013 mg GKE/g SE). Poređenjem dobijenih vrednosti za ekstrakte sa izmerenim vrednostima za BHA (IC_{50} = 0.13 ± 0.01 mg/mL) može se konstatovati da su ekstrakti pokazali slabiji anti-DPPH potencijal. Rezultati ovog rada su pokazali da *P. majus*, pored tradicionalne upotrebe u kulinarstvu, ima i potencijalnu primenu u prehrambenoj industriji kao prirodni izvor antioksidativnih jedinjenja.

Libyan *Prasium majus* L. as a natural source of antioxidants

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Prasium majus L. (Lamiaceae) is an aromatic scrub known as white hedge-nettle. It is polymorphic species, native in Mediterranean region of Europe, North Africa and Middle East. This plant is often used in traditional cuisine in the southern Mediterranean. Its medicinal significance is reflected through the treatment of gastrointestinal problems. The aim of this study was spectrophotometric measurement of total phenol and flavonoid contents and antioxidant effects of wild-growing *P. majus* from Libya as potentially new natural antioxidant. Aerial parts in flowering stage were extracted using different solvents (methanol, ethanol, ethyl-acetate and water) by ultrasonic extraction. Total phenolic contents, along with determination of antioxidant effects of extracts in terms of DPPH and ABTS scavenging activity were measured. The methanol extract (c = 1 mg/mL), showed to possess the highest content of phenols (97.833 ± 0.015 mg GAE/g of dry extract (DE) and the best antiradical activity due to ABTS test (0.791 ± 0.003 mg vit. CE/g of DE). The highest content of flavonoids was recorded in ethyl-acetate extract (79.077 ± 0.066 mg QE/g of DE), which also had high potency in neutralization of ABTS radicals (0.674 ± 0.012 mg vit. CE/g of DE). All samples demonstrated lower activity in comparison to quercetin hydrate (2.75 ± 0,000 mg vit. CE/g of DE). The most effective sample in DPPH assay was aqueous extract with IC_{50} value of 3.66 ± 0.01 mg/mL, which also had significant amount of total phenols (84.979±0.013 mg GAE/g of DE). Still, in comparison to all tested samples, BHA exhibited better anti-DPPH potential with IC_{50} of 0.13±0.01 mg/mL. This study showed that *P. majus*, besides traditional use, has potential in food industry as natural source of antioxidants.

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Primena margine izloženosti (MI) pristupa u proceni rizika od aflatoksina M1 u mleku

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Mleko je visoko vredna životna namirnica, izvor makro i mikronutritijenata neophodnih za rast i razvoj ljudskog organizma, prvenstveno dece. Međutim, mleko može biti kontaminirano hemijskim i/ili biološkim hazardima, uzročnicima akutnih i hroničnih oboljenja kod ljudi. Aflatoksin M1 (AFM1) je hidroksilisani metabolit koji se izlučuje putem mleka sisara hranjenih hranom kontaminiranom aflatoksinom B1. Internacionalna agencija za izučavanje raka (IARK) svrstala je AFM1 u grupu 1 kancerogena (hepatocelularni karcinom). Hepatocelularni (primarni) karcinom (PKJ) zauzima drugo mesto po stopi smrtnosti kod ljudi obolelih od kancera, sa stopom morbiditeda od 550000–600000 na godišnjem nivou. Aflatoksini ispoljavaju sinergistički efekat sa hepatitis B i C virusom (HBV i HCV) te je kod osoba izloženih sinergističkom dejstvu ova dva hazarda, rizik od pojave PKJ 30 puta veći u odnosu na individue izložene dejstvu samo AFM1. Uzimajući u obzir navedene činjenice, ispitivanja zastupljenosti AFM1 u mleku predstavlja jedan od prioriteta u očuvanju javnog zdravlja građana Srbije. Cilj ovog istraživanja je bio da se utvrdi: a) zastupljenost AFM1 u sirovom i termički obrađenom kravljem mleku, b) procena dnevne izloženosti stanovništva AFM1 putem mleka i c) karakterizacija rizika metodologijom propisanom za kancerogena i genotoksična jedinjenja (MI). U 2015. ukupno je analizirano 1408 i 468 uzoraka sirovog i termički obrađenog mleka, ponaosob. U 2016. godini analizirano je ukupno 3646 uzoraka sirovog i 765 uzoraka termički obrađenog kravljeg mleka. Rezultati istraživanja ukazuju da je zastupljenost AFM1 u 2016. godini bila veća u odnosu na 2015. godinu (85% *vs*.70% sirovo mleko i 98,4% *vs*. 77,8% termički obrađeno). U skladu sa preporukama Evropske agencije za bezbednost hrane (EFSA) u slučajevima kada su vrednosti MI <10000 smatra se da rizik postoji. U našim istraživanjima vrednosti MI su se kretale u osegu od 837 do 1304 iz čega se može zaključiti da rizik od AFM1 putem kravljeg mleka postoji.

Application of the margin of exposure (MoE) approach to risk assessment of aflatoxin M1 in milk

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Milk is a high-value animal food, a source of macro and micronutrients necessary for the growth and development of the human organism, primarily children. However, milk may be contaminated by chemical and / or biological hazards, causative agents of acute and chronic diseases in humans. Aflatoxin M1 (AFM1) is a hydroxylated metabolite of aflatoxin B1 (AFB1) that is excreted in milk of mammals fed with AFB1 contaminated food or feeds. Aflatoxin M1 is carcinogenic mycotoxin listed as a group I carcinogen by the International Agency for Research on Cancer (IARC). Hepatocellular carcinoma (HCC), is the second leading cause of cancer deaths worldwide, with roughly 550,000–600,000 new HCC cases globally each year. Aflatoxins have a synergistic effect on hepatitis B and C virus (HBV and HCV), therefore risk of liver cancer in individuals exposed to chronic HBV and HCV infection and AF′s is up to 30 times greater than the risk in individuals exposed to AF′ only.
Taking into account the above facts, monitoring of the presence of AFM1 in milk is one of the priorities in protecting the Public Health in Serbia. The aim of this study was to determine: a) the presence of AFM1 in raw and thermally processed cow milk, b) estimate the dietary exposure of AFM1 by milk, and c) risk characterization by the methodology proposed for carcinogens compounds (MOE). In 2015, total of 1408 and 468 samples of raw and processed milk were analyzed, respectively. In 2016, a total of 3646 samples of raw and 765 samples of thermally-treated cow's milk were analyzed. The results of the survey indicate that the representation of AFM1 in 2016 was higher than in 2015 (85% vs. 70% of raw milk and 98.4% vs. 77.8% processed milk). In accordance with the recommendations of the European Food Safety Authority (EFSA) in cases where MOE values is below of 10000 represents a higher risk than a large MOE. In our research MI values ranged from 837 to 1304, from which it can be concluded that the risk of AFM1 through cow milk exists.

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BKHP41 / FQSP41

Procena sadržaka makro i elemenata u tragovima u dve sorte vinove loze i vinu

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Jedan od glavih koraka u sprečavanju zagađenja poljoprivrednih proizvoda jeste monitoring koncentracija makro i elemenaata u tragovima, koji prisutni u višku mogu da budu toksični za biljke i čoveka. Uzorkovani su listovi i grožđe dve vrste vinove loze (*Cabernet sauvignon* and *Sauvignon blanc*) u vinogradu koji se nalazi u poljoprivrednoj oblasti „Oplenac vinski put“. Uzorci vina (crvenog i belog) su napravljeni od grožđa koje je uzorkovano u kada i uzorci grožđa za analizu. Koncentracije 22 elementa (Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li,Mg, Mn, Na, Ni, Pb, Sb, Sr, V, Zn) su određene u grožđu (celim bobicama, kožici, pulpi, semenu) i vinu korišćenjem ICP-OES i ICP-MS metoda. Da bi procenili potencijalni i kancerogeni rizik po zdravlje konzumatori grožđa vina primenjene su formule koje su dostupne na sajtu „The Risk Assessment Information System, RAIS“.
Cabernet sauvignon je potomak sorta *Sauvignon blanc* sorte i između koncentracija elemenata izmerenih u ove dve sorte ne postoji statistički značajna ($p<0.05$) razlika. Koncentracije toksičnih elemenata (As, Cd i Pb) u grožđu su izmerene u koncentracijama nižim od maksimalno dozvoljenih koncentracija propisanim (MDK) zakonskim aktima. Na osnovu koeficijenta korelacije, između analiziranih delova vinove loze, Ba uglavnom potiče iz zemljišta, dok Mn može poticati iz folijarne primene pesticida koji sadrže Mn. Na osnovu nacionalnih i međunarodnih regulativa, koncentracije toksičnih elemenata u uzorcima vina nisu izmerene u vrednostima većim od MDK. Veće koncentracije Al, Fe i Na može uticati na organoleptičke karakteristike vina, koja se obično naziva „mineralitet“ vina. Na osnovu procene rizika po zdravlje ljudi, obe analizirane sorte (*Cabernet sauvignon* and *Sauvignon blanc*) grožđa i crveno i belo vino su bezbedni za konzumaciju.

Assessment of major and trace element content in two grapevine species and wine

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One of the most important steps in preventing contamination of agricultural products is monitoring of major and trace elements concentrations, which present in excess could be toxic form plants and humans. Leaf and grape berry of two grapevine species (*Cabernet sauvignon* and *Sauvignon blanc*) were sampled in the vineyard located in the agricultural area “Oplenac Wine Route”. The wine samples (red and white) were prepared from the grape collected during the studied harvest. The concentrations of 22 elements (Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Na, Ni, Pb, Sb, Sr, V, Zn) were determined in grape berry (whole berry, skin, pulp and seed) and wine using ICP-OES and ICP-MS. To assess the potential and carcinogenic risk for grape and wine consumers the formulas available at The Risk Assessment Information System, RAIS were applied.
Cabernet sauvignon is the progeny of the *Sauvignon blanc* species and between the element concentrations of these two species were not observed significant differences ($p<0.05$). The toxic element (As, Cd and Pb) concentrations in the grape were measured in concentrations lower than the maximum allowable concentrations (MAC).
According to multiple correlation coefficients, between the concentrations of the analysed grapevine parts, Ba could mostly originate from the soil while Mn could mostly originate from the foliar application of Mn-pesticides. According to the national and international regulations, the concentrations of toxic elements in the wine samples were not measured above the MAC. The higher content of Al, Fe and Na in wine could have an influence on the organoleptic peculiarities of these wines, normally referred as “minerality”. According to the health risk assessment, both the studied grapevine species (*Cabernet sauvignon* and *Sauvignon blanc*) and the white and red wine seems to be safe for consumption.

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Upotreba *Lactococcus lactis* subsp. *lactis* BGBU1-4, producenta bakteriocina, u biokontroli *Listeria monocytogenes* i *Staphylococcus aureus* kod sireva u tipu Kvarka

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Patogeni hrane, poput *Listeria monocytogenes*, *Staphylococcus aureus*, *Salmonella* spp. i *Escherichia coli* predstavljaju izazov za prehrambenu industriju. U tom smislu se izdvajaju *L. monocytogenes* i *S. aureus* kao neretki uzročnici bolesti i alimentarnih toksiinfekcija povezanih sa mlečnim proizvodima.
U ovom radu ispitivana je upotreba *Lactococcus lactis* subsp. *lactis* BGBU1-4, producenta bakteriocina, u biokontroli *L. monocytogenes* i *S. aureus* kod sireva u tipu Kvarka. Takođe, ispitivan je uticaj BGBU1-4 na ukupan broj kvasaca i plesni, kao i senzorna ocena sireva (40 ocenjivača). Napravljene su dve varijante sireva: sir u tipu Kvarka (Q) i sir u tipu Kvarka sa dodatkom soja BGBU1-4 (Qbu). Sirevi su kontaminirani sa *L. monocytogenes* ili *S. aureus* – 4 log g^{-1}. Svi uzorci su čuvani 21 dan na 4°C.
Za određivanje broja *L. monocytogenes* i *S. aureus*, korišćeni su Oxford i Baird-Parker agar, redom, dok je za određivanje broja kvasaca i plesni korišćen Rose Bengal agar. Senzorna analiza je urađena testom trougla. U siru Q, kontaminiran sa *L. monocytogenes*, broj ćelija *L. monocytogenes* opada za manje od 1 log, dok u siru Qbu, takođe kontaminiran sa *L. monocytogenes*, broj ćelija *L. monocytogenes* opada za više od 2 log, posle 21. dana skladištenja. U sirevima koji su kontaminirani sa *S. aureus*, broj ćelija *S. aureus* opada za 2 log u siru Q, dok u siru Qbu broj ćelija *S. aureus* opada za više od 3 log, nakon 15. dana skladištenja. Broj kvasaca i plesni eksponencijalno raste tokom tri nedelje skladištenja u obe varijante sira. Međutim, u siru Qbu, povećanje broja kvasaca i plesni je za više od 1 log slabiji. Test trougla je pokazao razlike u senzornim karakteristikama Q i Qbu sira.
Soj BGBU1-4 inhibira rast *L. monocytogenes*, *S. aureus,* kvasaca i plesni kod sireva u tipu Kvarka i na osnovu toga može imati potencijalnu ulogu u prevenciji kontaminacije sireva u toku njihove proizvodnje.

Application of bacteriocin-producing *Lactococcus lactis* subsp. *lactis* BGBU1-4 in the bio-control of *Listeria monocytogenes* and *Staphylococcus aureus* in Quark type cheese

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Food-borne pathogens such as *Listeria monocytogenes*, *Staphylococcus aureus*, *Salmonella* spp. and *Escherichia coli* are of major concern in food industry. In particular, *L. monocytogenes* and *S. aureus* are causative agents of outbreaks associated with dairy products.
Aim of this study was to evaluate *Lactococcus lactis* subsp. *lactis* BGBU1-4 as protective culture against *L. monocytogenes* and *S. aureus* in Quark type cheese model. Additionally, we investigated its inhibitory activity toward yeast and molds, and evaluated its effect on sensory properties of Quark type cheese (40 panelists).
Two independent batches of cheeses were made: Quark type cheese (Q) and Quark type cheese with addition of BGBU1-4 (Qbu). Cheeses were contaminated with – 4 log g^{-1} of *L. monocytogenes* or *S. aureus*. All samples were stored at 4°C for 21 days. *L. monocytogenes* and *S. aureus* were enumerated on Oxford and Baird-Parker plates, respectively, while yeast and molds were counted on Rose Bengal plates. Sensory analysis was performed by triangle test three weeks after production. In the Q and Qbu cheese contaminated with *L. monocytogenes*, number of *L. monocytogenes* decreased less than 1 log and more than 2 logs, respectively, after 21 days of storage. In the Q cheese contaminated with *S. aureus*, counts of *S.aureus* decreased for 2 logs, while in the Qbu cheese decreased more than 3 logs, after 15 days of storage. Number of yeast and molds increased during storage in both Q and Qbu. However in Qbu cheese, increase of yeast and molds was more than 1 log lower. Triangle test reveled differences in sensory characteristics of Q and Qbu.
In conclusion, BGBU1-4 inhibited growth of *L. monocytogenes*, *S. aureus*, yeast and molds in Quark type cheese and thus could be used for prevention of hygienic risks during cheese manufacture.

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BKHP43 / FQSP43

Farmakološka svojstva jestive biljke *Anthriscus cerefolium* L. Hoffm

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Anthriscus cerefolium, poznat i kao biljka krbuljica, pripada familiji Apiaceae. Ima dugu istoriju upotrebe u tradicionalnoj medicini i takođe se koristi kao začin u hrani. Cilj ovog istraživanja bila je naučna potvrda farmakološkog značaja ove biljke određivanjem ukupnog sadržaja polifenola i flavonoida u etil-acetatnom ekstraktu, kao i utvrđivanje antioksidantne, antienzimatske i antibakterijske aktivnosti. Ukupni sadržaji polifenola i flavonoida kvantifikovani su spektrofotometrijskim metodama. Antioksidantna aktivnost ekstrakta merena je različitim testovima, uključujući test sa fosfomolibdenom, DPPH, ABTS, CUPRAC, FRAP i Metal helirajuću aktivnost. U ispitivanjima inhibicije enzima korišćeni su: acetilholinesteraza (AChE), butirilholinesteraza (BChE), amilaza, glukozidaza i tirozinaza kako bi se odredile antienzimske aktivnosti ekstrakta. Ispitana je i antibakterijska aktivnost etil-acetatnog ekstrakta na osam patogenih bakterija među kojima su poznati kontaminanti hrane, kao i patogeni ljudi, životinja i biljaka. Ukupni sadržaj polifenola (15.07 mgGAE/g ekstrakta) i ukupni sadržaj flavonoida (1.95 mgRE/g ekstrakta) u ekstraktu ukazuju na potencijalnu biološku aktivnost ove biljke. Najviši antioksidantni kapacitet pokazan je u testu sa fosfomolibdenom (1.25 mmol/g ekstrakta), dok su najniži rezultati dobijeni u CUPRAC testu (51.71 mgTE/g ekstrakta). Svi testirani enzimi su inhibirani. Najveća inhibicija enzima pokazana je za amilazu čiji se inhibitori koriste u terapiji dijabetesa (0.73 mmolACAE/g ekstrakta). Etil-acetatni ekstrakt *A. cerefolium* pokazao je umerenu antibakterijsku aktivnost na odabrane Gram-pozitivne i Gram-negativne bakterije s minimalnim inhibitornim i baktericidnim koncentracijama u rasponu od 0.07 do 0.14 mg/mL. Rezultati istraživanja ističu potencijalnu primenu *A. cerefolium* u terapiji oksidativnog stresa, dijabetesa tip II, Alchajmerove i Parkinsonove bolesti, kao i bakterijskih infekcija. Biljka krbuljica predstavlja prirodni izvor bioaktivnih jedinjenja koji bi mogli biti korisni za ljudsko zdravlje.

Pharmacological properties of edible plant *Anthriscus cerefolium* L. Hoffm

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Anthriscus cerefolium, also known as chervil, is a plant from Apiaceae family. It has a long history of use in traditional medicine and is also used as flavoring agent in food. The aim of this study was to scientifically validate pharmacological features of this plant by evaluating its total phenolic and flavonoid contents, antioxidant, enzymes inhibitory and antibacterial activities of its ethyl-acetate extract. Total phenolic and total flavonoid contents were quantified by spectrophotometric methods. Antioxidant activity of the extract was measured by different assays including Phosphomolybdenum test, DPPH, ABTS, CUPRAC, FRAP and Metal chelating activity. Acetylcholinesterase (AChE), Butyrylcholinesterase (BChE), amylase, glucosidase and tyrosinase were used in enzymes inhibition assays for the evaluation of antienzymatic properties of the extract. In addition, we evaluated the antibacterial activity of ethyl-acetate extract on eight pathogenic bacteria among which are well known food contaminants, as well as human, animal and plant pathogens. Total phenolic (15.07 mgGAE/g of extract) and total flavonoid (1.95 mgRE/g of extract) contents of the extract match with biological activity of this plant. The highest antioxidant capacity was shown in phosphomolybdenum test (1.25 mmolTE/g of extract), while the lowest results were obtained in CUPRAC test (51.71 mgTE/g of extract). All tested enzymes were inhibited. The strongest enzyme inhibition was shown for diabetes-linked enzyme amylase (0.73 mmolACAE/g of extract). Ethyl-acetate extract of *A. cerefolium* exhibited moderate antibacterial effect on some Gram-positive and Gram-negative bacteria with minimal inhibitory and bactericidal concentrations in range from 0.07 to 0.14 mg/mL. This study highlights possible use of *A. cerefolium* in the treatment of oxidative stress, diabetes type II, Alzheimer's and Parkinson's diseases and bacterial infections. The plant is a natural source of bioactive compounds that could be beneficial to the human health.

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BKHP44 / FQSP44

Biljke kao prirodni antimikrobni agensi za bezbednost hrane

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Biljke i njihove komponente pokazuju antimikrobnu (AM) aktivnost protiv različitih patogena i mikroorganizama koji dovode do kvarenja hrane. Poslednjih godina postoji trend u prehrambenoj industriji koji podrazumeva korišćenje prirodnih AM aditiva za izradu ambalaže, jestivih folija i premaza za produženje roka trajanja kvarljivih i slabo obrađenih namirnica, poput mesa i povrća. Mnoge biljne vrste iz porodice Lamiaceae se od davnina koriste u tradicionalnoj medicini, kulinarstvu i kao konzervansi hrane. Ovo istraživanje je rađeno u cilju ispitivanja antibakterijskih aktivnosti odabranih biljaka porodice Lamiaceae, kultivisanih u Srbiji. Biljni materijal je nabavljen iz Instituta za proučavanje lekovitog bilja „Dr Josif Pančić". Sirovi ekstrakti su pripremljeni korišćenjem 70% metanola, 70% etanola i vrele destilovane vode. Test minimalne inhibitorne koncentracije izveden je na tri Gram-pozitivne (G^+) i tri Gram-negativne (G^-) bakterije (ATCC kolekcija) koje se obično koriste za ispitivanje AM potencijala, a koje su takođe poznate i kao uzročnici kontaminacije namirnica. Rezultati su pokazali da su testirane G^- bakterije rezistentnije na biljne ekstrakte od G^+, sa izuzetkom etanolnih ekstrakta, koji su pokazali baktericidni efekat na *Pseudomonas aeruginosa* (opseg koncentracija od 0,25-0,5 mg/mL). S druge strane, među G^+ bakterijama, *Enterococcus faecalis* je pokazao manju osetljivost, a ekstrakti su bili efikasniji protiv *Staphylococcus aureus* i *Bacillus subtilis*. Etanolni ekstrakt izopa i metanolni ekstrakt planinskog čaja su pokazali najjaču baktericidnu aktivnost protiv *B. subtilis* (0,03 mg/mL). Takođe, etanolni ekstrakti ruzmarina i žalfije su pokazali značajnu bakteriostatičku aktivnost prema pomenutom bakterijskom soju (0,06 mg/mL). Na osnovu navedenih rezultata se može zaključiti da su neke od testiranih biljnih vrsta potencijalni alternativni AM agensi prirodnog porekla.

Plants as natural antimicrobial agents for food safety

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Plants and some of their constituents have shown antimicrobial (AM) activity against different food pathogens and spoilage microorganisms. A promising trend in food industry nowadays involves incorporating these natural AM additives into packaging materials, edible films and coatings for extending the shelf life of perishable and minimally processed foods as, for example, meat and vegetables. Numerous Lamiaceae species have a long history of being used in traditional medicine, cookery, and as food preservatives. Our current study was aimed to examine the antibacterial activity of the selected plants belonging to the Lamiaceae family, which were cultivated in Serbia. Plant material was obtained from the Institute for Medicinal Plant Research "Dr Josif Pančić". Crude extracts were prepared using 70% methanol, 70% ethanol and hot distilled water. The minimum inhibitory concentration test was performed on three Gram-positive (G^+) and three Gram-negative (G^-) bacteria (ATCC collection) commonly used to investigate the AM potential, also known to cause food-borne illnesses. The results have shown that the tested G^- bacteria are more resistant to the plant extracts than G^+ ones, with the exception of the ethanolic extracts, which showed bactericidal effect on *Pseudomonas aeruginosa* (concentration range from 0.25–0.5 mg/mL). On the other hand, among G^+ bacteria, *Enterococcus faecalis* showed less sensitivity, however the extracts were more efficient against *Staphylococcus aureus* and *Bacillus subtilis*. Ethanolic extract of hyssop and methanolic one of mountain tea exhibited the highest bactericidal activity against *B. subtilis* (0.03 mg/mL). Additionally, ethanolic extracts of rosemary and sage have exhibited significant bacteriostatic activity against *B. subtilis* (0.06 mg/mL). In conclusion, the given results indicate that some of the tested plant species are potential alternative AM agents of natural origin.

BKHP45 / FQSP45

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BEZBEDNOST I KVALITET HRANA / FOOD QUALITY AND SAFETY

Određivanje sadržaja vitamina C u voću

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Vitamin C predstavlja jedan od najznačajnijih vitamina za čovekov organizam. Od velikog značaja je njegova antioksidativna aktivnost a ima ulogu i u brojnim procesima kao što su sinteza kalogena, apsorpcija gvožđa, stvaranje zuba i kostiju.
Čovekov organizam ne može da sintetiše vitamin C već je neophodno da ga unosi putem hrane. Preporučeni dnevni unos ovog vitamina iznosi 75 mg za žene i 90 mg za muškarce. Za žene u trudnoći, žene koje doje kao i pri prelomu kostiju potrebna količina vitamina C se povećava i do 200 mg dnevno. Takođe, potrebu za povećanom količinom vitamina C imaju i pušači, sportisti, radnici na teškim fizičkim poslovima kao i osobe koji se bave visoko stresnim poslovima.
Namernice bogate vitaminom C su bobičasto voće (crna ribizla), šipak, paradajz, paprika kao i zeleno povrće (zelena paprika), kupus. Posebno važnim izvorom vitamina C smatra se citrusno voće (limun, grejpfrut, mandarine, pomorandža).
U ovom radu sadržaj vitamina C u soku odabranih svežih citrusa (pomorandža, grejpfrut, mandarine, limun) određen je primenom dve metode: direktnom jodimetrijskom titracijom i titracijom primenom Tillmansovog reagensa.
Dobijeni rezultati prikazani su kao mg vitamina C u 100g uzorka.
Sadržaj vitamina C određen direktnom jodimetrijskom titracijom u 100g uzorka limunovog soka iznosio je 62,7 mg, u 100 g soka pomorandže 75,4 mg, u 100 g soka grejpfruta 41,2 mg i u 100 g soka mandarine 38,6 mg.
Rezultati dobijeni primenom Tillmansovog reagensa (u 100g uzorka limunovog soka 64,2 mg, u 100 g soka pomorandže 73,6 mg, u 100 g soka grejpfruta 40,4 mg, u 100 g soka mandarine 37,2 mg vitamina C) bili su usaglašeni sa rezultatima prethodno dobijenim direktnom jodimetrijskom titracijom.
Pri tome treba imati u vidu da sadržaj vitamina C u voću i povrću varira u zavisnosti od načina gajenja, čuvanja, zrelosti odnosno, starosti. Takođe u zavisnosti od dužine stajanja pripremljenog soka moguć je znatan gubitak sadržaja vitamina C.

Determination of vitamin C content in fruit

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Vitamin C is one of the most important vitamins for the human body. It's antioxidant activity is of great importance, but it also has a role in numerous processes such as synthesis of calcium, iron absorption, tooth and bone formation.
The human body cannot synthesize vitamin C and it is necessary to bring it through food. The recommended daily intake of vitamin C is 75 mg for women and 90 mg for men. For women in pregnancy, women who are breastfeeding and bone fractures require the amount of vitamin C to increase to 200 mg per day. Also, the increased need for vitamin C include smokers, athletes, hard workers, and people who are struggling with high-stress jobs.
Food rich in vitamins C include berry fruits (black currant), tomato, pepper and green vegetables (green peppers), cabbage. A particularly important source of vitamin C is citrus fruit.
In this work, the content of vitamin C in the juice of selected fresh citrus (orange, grapefruit, mandarine and lemon) was determined using two methods: direct jodimetric titration and titration using the Tillman's reagent.
The results obtained are shown as mg vitamin C in 100g of sample.
The content of vitamin C determined by direct jodimetric titration in 100g of lemon juice sample was 62.7 mg, in 100 g of orange juice 75.4 mg, in 100 g of grapefruit juice 41.2 mg and 100 g of mandarine juice 38.6 mg.
Results obtained using the Tillman's reagent (in 100g sample of lemon juice 64.2 mg, 100 g of orange juice 73.6 mg, 100 g of grapefruit juice 40.4 mg in 100 g of mandarine juice 37.2 mg of vitamin C) were in agreement with the results obtained using direct jodimetric titration.
It should be considered that the content of vitamin C in fruit varies depending on growth, storage conditions and ripeness of food. Also, depending on the length of preparation citrus juice, a significant loss of vitamin C content is possible.

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BEZBEDNOST I KVALITET HRANA / FOOD QUALITY AND SAFETY

BKHP46 / FQSP46

Određivanje sadržaja kinina u različitim bezalkoholnim osvježavajućim pićima

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Kinin, alkaloid izolovan iz kore biljke *Cinchona succirubra, Rubiaceae*, vjekovima se koristio u profilaksi i terapiji malarije, a u narodnoj medicini u terapiji groznice i bolova. Danas se najviše koristi kao sredstvo za postizanje gorkog ukusa u bezalkoholnim osvježavajućim pićima. Prema „Pravilniku o kvalitetu osvježavajućih bezalkoholnih pića“, ova pića mogu sadržavati najviše 85 mg/L kinina. Postoje podaci da kod određene populacije, pića koja sadrže kinin, konzumirana u većim količinama, mogu izazvati imunološku trombocitopeniju, te indukovati neonatalnu glukoza-6-fosfat-dehidrogenaza krizu kod dojenčadi čije su majke konzumirale ova pića. Analizirana su bezalkoholna osvježavajuća pića sa kininom, prikupljena na tržištu Republike Srpske. Pripremljenim uzorcima određena je apsorbancija, i na osnovu kalibracione krive određen sadržaj kinina. Sadržaj kinina u tonicima bio je manji (22,74 - 41,32 mg/L) u odnosu na pića vrste bitter lemon (81,32 - 86,11 mg/L). S obzirom da je kod dvije vrste pića dobijen sadržaj veći od dozvoljenog, neophodno je pojačati kontrolu sadržaja ovog jedinjenja u pićima, s ciljem da se spriječi njegov štetni efekat na zdravlje osoba sa određenim faktorom rizika za navedena oboljenja. Trudnicama i dojiljama se savjetuje izbjegavanje konzumiranja navedenih pića.

Determination of quinine content in various non-alcoholic refreshing drinks

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Quinine, alkaloid isolated from the cortex of Cinchona succirubra, Rubiaceae, for centuries has been used in the prophylaxis and therapy of malaria, and also in the treatment of fever and pain in the traditional medicine. Today, it's mostly used to achieve bitter taste in non-alcoholic drinks. According to the "Regulations for quality of refreshing non-alcoholic beverages", these beverages may not contain more than 85 mg/L of quinine. There are some data that indicate that, in certain population, beverages containing quinine, in certain quantities, can cause immune trombocytopenia, and neonatal glucose-6-phosphate-dehydrogenase crisis in newborns whose mothers consumed these drinks. Non-alcoholic refreshing beverages with kinine were analyzed, collected on the market in Republic of Srpska. Apsorbance was measured for the each sample, and calibration curve was used to determine quinine concentration. The content of the quinine was lower in tonics (22.74 – 41.32 mg/L) than in the bitter lemon beverages (81.32 – 86.11 mg/L). Considering that, in two beverage types, the content of quinine was higher than allowed, it's necessary to intesify the control of this compound, to prevent it's adverse effects on the health of persons with a certain risk factor for mentioned diseases. Pregnant women and nursing mothers are advised to avoid consuming these drinks.

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BKHP47 / FQSP47

Uticaj voćnih sokova dobijenih iz organskog i konvencionalno gajenog južnog voća na Brigs-Raušer oscilatornu reakciju

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Brigs-Raušer (BR) oscilatorna reakcija predstavlja sistem veoma osetljiv na spoljne uticaje - pertubacije različitim reaktivnim analitama, te se stoga uspešno koristi u određivanjima koncentracija analita, ali i za ispitivanje njihovih osobina (antioksidativne, antiradikalske, katalitičke itd.). Promene reakcione dinamike sa dodatkom analita su ono što se ovom prilikom opaža i meri, i iz čega se mogu dobiti informacije o osobinama ispitivanog analita. Posebno je značajna primena BR reakcije u ispitivanjima antioksidativnih osobina analita. U ovo radu ispitivan je uticaj sokova nara (*Punica granatum*), kivija (*Actinidia deliciosa*) i limuna (*Citrus x limon*), za koje se zna da poseduju dobre antioksidativne karakteristike. Osnovna ideja je ispitati razliku u odzivu BR reakcije između voćnih sokova dobijenih iz organski i konvencionalno gajenog voća. Sokovi su dobijeni ceđenjem svežeg voća i filtriranjem dobijene smeše. Svi eksperimenti su sprovedeni u zatvorenom dobromešajućem reaktoru (σ = 900 obrt/min) na temperaturi od 36.8 ± 0.2 °C. Ukupna reakciona zapremina je 25 ml, dok su početne koncentracije reaktanata: $[C_3H_4O_4]_0$ = 0.0789 M , $[MnSO_4]_0$ = 0.00752 M, $[HClO_4]_0$ = 0.03 M, $[KIO_3]_0$ = 0.0752 M i $[H_2O_2]_0$ = 1.269 M. Odabrani eksperimentalni uslovi odgovaraju fiziološkoj temperaturi, dok je pH reakcije identičan pH ljudskog želudca (pH<2). Filtrati svežeg soka su dodavani u zapremini od 50 µl u oscilatornom režimu, 30 s nakon dodatka poslednjeg reaktanta (vodonik-peroksida). Dobijeni rezultati pokazuju da najveću sposobnost inhibiranja oscilatorne dinamike ima limun, zatim nar, pa kivi, ukazujući i na opadanje antioksidativne aktivnosti u ovom smeru. Takođe, ukupna antioksidativna sposobnost organskog i konvencionalno gajenog voća nije se značajno razlikovala.

The influence of fruit juices obtained from selected organic and conventional fruits on the Briggs-Rauscher oscillatory reaction

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The Briggs-Rausher (BR) oscillatory reaction is a very sensitive system on perturbation with different reactive analytes, therefore it can be successfully used for analyte concentration determination as well as for investigation of their properties (antioxidative, antiradical, catalytic, etc.). Changes in reaction dynamics with analyte addition can be observed and measured, and from them, we can get information about analyte characteristics. The BR reaction usage is especially important in antioxidative properties examination. In this work is investigated the antioxidative ability of pomegranate (*Punica granatum*), kiwi (*Actinidia deliciosa*) and lemon (*Citrus x limon*) juices thought their inhibition of oscillatory dynamics. The basic idea is to examine the difference between fruit juices obtained from organic fruits and the conventional ones by using BR reaction. Juices are prepared with fresh fruits blended and filtrated. The experiments are performed in the closed well-stirred reactor (σ = 900 rpm), while the temperature is maintained at 36.8 ± 0.2 °C. Total reaction volume was 25 ml, and the initial concentrations of the reactants were: $[C_3H_4O_4]_0$ = 0.0789 M, $[MnSO_4]_0$ = 0.00752 M, $[HClO_4]_0$ = 0.03 M, $[KIO_3]_0$ = 0.0752 M i $[H_2O_2]_0$ = 1.269 M. The chosen experimental conditions correspond to physiological temperature, while the pH value of the reaction is identical like pH of human stomach (pH<2). The aliquot of fresh juice filtrates (50 µl) was added to the oscillatory regime, 30 s after the last reactant (hydrogen-peroxide) addition. The results obtained point out that lemon has the greatest ability for oscillatory dynamics inhibition, then pomegranate, and kiwi is the last one, indicating that antioxidative activity decreasing in this direction. Additionally, the total antioxidative ability of organic and conventional selected fruits did not differ significantly.

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BKHP49 / FQSP49

Izolovanje i ekstrakcija galne kiseline i flavan-3-ola u uzorcima autohtonih sorti grožđa„Prokupac“ i „Smederevka“

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Benigna hiperplazija prostate (BPH) je jedna od najčešćih bolesti muškaraca srednjih godina. Poznato je da derivati flavan-3-ola sa jednom ili više jedinica pozitivno utiču na prevenciju pojave benigne hiperplazije prostate. Grožđe je jedan od najvažnijih izvora ovih jedinjenja. U tradicionalnoj medicini grožđe se koristi za lečenje grla, konstipacije, kože, bubrega i jetre. Cilj ovog rada je proučavanje dejstva ekstrakta galne kiseline i flavan-3-ola iz autohtonih sorti crnog-„Prokupac“ i belog-„Smederevka“ grožđa na pacijente sa beningnom hiperplazijom prostate.
Suve semenke grožđa su ustinjene i ekstrahovanie sa 70% etanolom. Ovako dobijeni ekstrakti klinički su ispitani. U kliničkoj studiji je učestvovalo 30 pacijenata podeljenih u tri grupe: kontrolnu, grupu koja je uzimala semenke „ Prokupca“ i grupu koja je uzimala semenke „Smederevke“. Koncentracija galne kiseline i flavan-3-ola određenaje u urinu i semenoj tečnosti,je pre uzimanja ekstrakta i tretmana u trajanju od mesec dana pomoću *UHPLC-DAD MS/MS* tehnike. Dobijeni rezultati pokazuju veći sadržaj flavan-3-ola u uzorcima, posle uzimanja ekstrakata.

Theisolation and various extraction procedure of gallic acid and flavan-3 ole in autothonic „Prokupac“and „Smederevka“ grapes

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Bening prostate hyperplasia (BPH) has been one of the most abundant disease in middle age man. It’s well known that monomeric and polyphenolic derivate of flavan3-ole exhibits protective effect on benign prostate hyperplasia. Traditionally, grapes were used to treat throat, infection and dried grapes (raisins) to treat constipation, skin, kidney, and liver diseases.The framework of this study was to examine extracts of gallic acid and flavan-3-ole from „Prokupac“ and „Smederevka“ autothonic variaty of grapes on pacients with BPH.
Dried grape seeds were pulverized and extracted with 70% acidified ethanol. These extract were subjected to clinical trial. The group of 30 patient were divided in three groups: control , group that take „Prokupac“ seed extract and „Smederevka“ seed extracts group. The concentration of gallic acid and flavan-3-ole were determined at beginning of the trial and after one month in urine and seminal fluids by UHPLC–DAD MS/MS technique. The concentration of Gallic acid and flava-3-ole was higher after taking the extracts.

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BEZBEDNOST I KVALITET HRANA / FOOD QUALITY AND SAFETY

BKHP50 / FQSP50

Određivanje sadržaja etanola u alkoholnim pićima metodom Furijeve infracrvene transformacije spektroskopski(FTIR)

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Spektroskopska tehnika u infracrvenoj (IR) oblasti zasnovana je na činjenici da mnogi molekuli snažno apsorbuju IR zračenja i da je stepen apsorpcije proporcionalan koncentraciji molekula. Određivali smo koncentraciju etanola u više vrsta alkoholnih pića FTIR metodom u talasnom opsegu IR regiona od 2500 do 25000 nm.
Analizirano je dvadeset vrsta alkoholnih pića. Kalibracija kriva je konstruisana pomoću Beer's Low metode uz konstantnu talasnu dužinu. Za konstrukciju krive koristili smo šest standarda u spektralnom opsegu od 400 do 4000 cm-1. Korelacioni faktor 0,9996 ukazuje na pouzdanu i linearnu kalibracionu krivu. Koncentracija etanola se kretala u opsegu od 1,00% do 53,26%. Nema nikakve pripreme uzoraka za ovu vrstu analize. Aparat je podešen na šesnaest skenova, a rezultati su dostupni za manje od jednog minuta. Pored toga, odlučili smo da uporedimo koncentracije etanola dobijene FTIR metodom sa metodom tečne hromatografije visokih performansi sa refractiv indeks detektorom (HPLC-RID). 70% rezultata određivanja koncentacije etanola u alkoholnim pićima, FTIR metodom, bilo je istovetno ili je ta razlika bila manja od 5%, od koncentacije određene HPLC-RID metodom. Preostalih 30% rezultata bilo je 5 do 10% različito, što nije značajan procenat, u odnosu na činjenicu da smo imali dve metode zasnovane na potpuno različitom principu.
Potvrdili smo da se za određivanje koncentracije etanola u alkoholnim pićima FTIR metoda može koristiti u našoj laboratoriji. Ovakve analize su veliki izazov za analitičara, posebno kada su u pitanju uzorci sa komplikovanim matriksom. Za početak napravili smo, jednu brzu i efikasnu metodu, za kvantitativno određivanje etanola u alkoholnim pićima.

Determination of ethanol content in alcoholic drinks by Fourier-transform infrared spectroscopy (FTIR)

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The technique of Infrared (IR) Spectroscopy is based on the fact that many molecules strongly absorb IR radiation and that the degree of absorption is proportional to the molecular concentration. We determined ethanol content in different kinds of alcoholic drinks by FTIR and the wavelength range of the IR region from 2500 to 25000 nm.
We analyzed twenty different kinds of alcoholic drinks. Calibration curve was made by simple Beer's Low method with constant pathlength. We used six standards of ethanol and spectral range from 400 to 4000 cm^{-1}. The correlation factor was 0.9996 which indicates a very good and linear calibration curve. The concentration of ethanol was from 1.0 % to 53.26%. There is no preparation of samples for this kind of analysis. We had sixteen scans and the results were done in less than one minute. Also, we decided to compare FTIR analysis of concentration of ethanol to high performance liquid chromatography with refractive index detector (HPLC-RID). 70% of our results of ethanol in alcoholic drinks by FTIR method were almost equal or less than 5% different from HPLC-RID method. The other 30% of results were different from 5 to 10%, which is not a significant percent, considering the fact that we had two methods with completely different principles.
We confirm that the method of analysis of ethanol by FTIR can be used in our laboratory for this purpose. These kinds of analyses are a big challenge for an analyst, especially when you have a complicated matrix. For the beginning we made one fast and precise method for quantification of ethanol in alcoholic drinks.

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BKHP51 / FQSP51

Određivanje glukoze u pićima pomoću amperometrijskog biosenzora sa medijatorom

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Biosenzori su analitički uređaji, koji biološki odgovor prevode u električni signal. Postoje tri generacije amperometrijskih enzimskih biosenzora. Druga generacija biosenzora, koristi veštačke medijatore ili nanomaterijale za transport elektrona od aktivnog mesta enzima do elektrode. Elektrode od ugljenične paste se često koriste kod amperometrijskih biosenzora. Komponente biosenzora su: grafit, parafinsko ulje, glukozo oksidaza, medijator i glutaraldehid. Kao medijator se koristio kompleks bakra sa šifovom bazom (diacetilaceton propilendiamin). Ispitivani biosensor je dao odgovor u linearnom opsegu od 0,5 mM do 5 mM, nagib je 0,0147 a r^2 0,9637. Biosenzori sa glukozo oksidazom i medijatorom se mogu koristiti za određivanje glukoze u uzorcima hrane. Ispitivani biosenzor je korišten za određivanje glukoze u uzorcima, komercijalno dostupnih pića (sok od jabuke i sok od pomorandže). Svi uzorci su spajkovani sa glukozom i procentni prinos (recovery) je preko 90 %.

Determination of glucose in beverages by amperometric mediated biosensor

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Biosensors are analytical devices, that convert a biological response into an electrical signal. Amperometric enzyme biosensors are divided into three generations. Second-generation biosensors use artificial mediators or nanomaterials to transport the electrons from active site of enzyme to the electrode. Carbon-paste electrodes are often applied in amperometric biosensors. Components of biosensor are: graphite powder, paraffin oil, glucose oxidase, mediator and glutaraldehyde. Copper Complex with Schiff base (diacetylacetone propylenediamine) was used as mediator. Investigated biosensor gave response in linear range from 0.5 mM to 5 mM, slope is 0.0147 and r^2 is 0,9637. Mediated biosensors with glucose oxidase can be used for determination of glucose in food samples. The investigated biosensor was used to determine the glucose in the samples, commercially available beverages (apple juice and orange juice). All samples were spiked with glucose and recovery is over 90 %.

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BKHP52 / FQSP52

Određivanje fenolnog sastava ekstrakta imele dobijenog subkritičnom vodom

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Imela poreklom iz Evrope (*Viscum album* L.) je privukla posebnu pažnju u tradicionalnom lečenju i medicini tokom proteklih vekova. Ekstrakti imele se najčešće primenjuju u nekonvencionalnoj terapiji kancera u centralnim evropskim zemljama. Ekstrakti imele predstavljaju kompleksne višekomponentne smeše, koje sadrže razne biološki aktivne supstance kao što su glikoproteini, polipeptidi, peptidi, amino kiseline, oligo- i poli-saharidi. U ovom radu je primenom HPLC metode vršeno određivanje sadržaja fenolnih komponenata u ekstraktima imele dobijenim sa vodom u subkritičnom stanju. Ekstrakcija je vršena na temperaturi od 120 °C i pritisku od 40 bar. Pokazalo se da su ekstrakti dobijeni subkritičnom vodom bogati fenolnim komponentama i da sadrže: kvercetin, luteolin, katehin, galnu kiselinu, propionsku kiselinu, ferulinsku i rozmarinsku kiselinu u koncentracijama 2,06; 6,60; 3,04; 0,34; 3,34; 0,52 i 2,14 mg/g, respektivno.

Investigation of phenolic composition of mistletoe subcritical water extracts

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The European mistletoe (*Viscum album* L.) has attracted special attention in traditional and conventional medicine throughout the centuries. Mistletoe extracts are the most frequently prescribed unconventional cancer therapy in central European countries. They are complex multi-component mixtures, containing various biologically active substances such as glycoproteins, polypeptides, peptides, amino acids, oligo- and poly-saccharides. In this study, the HPLC method was used for determination of the content of phenolic components in the mistletoe subcritical water extracts. The extraction was performed at a temperature of 120 °C and a pressure of 40 bar. The obtained extracts were rich in phenolic components, have been found to contain: quercetin, luteolin, catechin, galonic acid, propionic acid, ferulic and rosmarinic acid at concentrations of 2.06; 6.60; 3.04; 0.34; 3.34; 0.52 and 2.14 mg/g, respectively.

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Senzorska analiza meda – Koristan alat za karakterizaciju, određivanje kvalitete i porijekla meda

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Senzorska analiza hrane jedan je od najstarijih alata za utvrđivanje kvalitete hrane, njezine prihvatljivosti za konzumaciju pa čak i za utvrđivanje cjenovnog razreda prilikom odabira. Taj aspekt je prisutan i danas, a osobito je naglašen kod namirnica koje same po sebi postižu više cijene i predstavljaju svojevrsni kvalitativni izazov na tržištu hrane. To se jednako odnosi i na namirnice koje su izložene pritisku nelojalne konkurencije, patvorenju ili pak zamjeni s manje vrijednim verzijama. Med je jedna od namirnica koja se u to u potpunosti uklapa. Svojom raznovrsnošću na tržištu, svojom općenitom percepcijom kao „zdravom“ hranom ali i izraženom posvemašnjom neinformiranošću potrošača o karakterističnim svojstvima, med predstavlja pravi izazov za analitičke ali i regulatorne sisteme. I nacionalne i međunarodne. U pokušaju prilagodbe specifičnim izazovima karakterizacije medova na tržištu, Hrvatska udruga senzorskih analitičara meda (HUSAM) usvojila je i razvila nove standarde za provođenje senzorske analize meda. Osnova za to nalazi se u referentnoj EU regulativi koja je predvidjela ocjenjivanje senzorskih svojstava meda kao postupak komplementaran „klasičnim“ fizikalno-kemijskim i mikroskopskim analizama za dokazivanje kvalitete i porijekla meda. Do sada su se (ako uopće), prilikom stavljanja na tržište ili na natjecanjima kvalitete, koristile ne verificirane i zastarjele senzorske metode ocjenjivanja i koje su svojoj osnovi sadržavale ozbiljna ograničenja, kako u svojem principu (neselektivno kvantitativno bodovanje) tako i u načinima provođenja. Stoga je HUSAM pristupio razvoju modernog kvanititativno-deskriptivnog analitičkog postupka senzorske analize meda kao i provjere njegove objektivnosti i točnosti. Uslijed izraženog deficita adekvatno osposobljenih ocjenjivača meda, HUSAM je morao napraviti iskorak i u razvoju sistema ocjene kompetencija, probira ocjenjivača kao i njihove daljnje edukacije i treninga. Ovim radom bit će prikazan inovativni pristup senzorskoj analizi meda, namijenjen karakterizaciji i procjeni kvalitete meda u Hrvatskoj, nastao integriranjem suvremenih metodoloških alata. Radi se o uspostavljanju nove kvantitativno-deskriptivne metode ocjenjivanja kvalitete i podrijetla meda, integrirane u obliku specifične modularno koncipirane IT aplikacije. Njezinim se korištenjem osigurava cijeli niz razvojnih mogućnosti i pravaca čime se omogućuje procjena kako kvalitete meda tako i sagledavanje različita obilježja različitih vrsta meda. Time bi se osigurala njihova bolja valorizacija na tržištu kao i daljnji razvoj kriterija temeljem kojih se zasniva današnje definiranje kvalitete meda. Također se očekuje i bolje uočavanje propusta načinjenih tokom proizvodnog procesa (u realnom vremenu), unapređenje postupaka pripreme meda za tržište ali i osiguranje platforme za daljnji razvoj sistema ocjenjivanja meda.

Sensory Analysis of Honey – A Useful Tool For Characterization And Determination of Honey Origin

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Sensory food analysis is one of the oldest tools for determining the quality of food, its eligibility for consumption, and even for determining the price class during selection. This aspect is present even today, and it is particularly emphasized in foods that, as themselves, achieve higher prices and represent a kind of qualitative challenge to the food market. This applies equally to foods that are exposed to the pressure of non-loyal competition, fraud or replacement with less valuable versions. Honey is one of the foods that completely fits into that framework. With its diversity at market, its general perception of being "healthy" food however with expressed overall lack of information by consumers about its characteristic properties, honey represents a real challenge for both analytical and regulatory systems. Both national and international. In attempt to adapt to the specific challenges of honey characterization on the market, the Croatian Association of Honey Sensory Analysts (HUSAM) has adopted and developed new standards for conducting of the honey sensory analysis. The basis for this lays in the respective EU regulation which foresees the assessment of honey sensory properties as a procedure complementary to "classical" physical, chemical and microscopic analyses for evaluation of the quality and origin of honey. Until now, when placed on the market or in quality contents, if any, only non-verified and obsolete sensory evaluation methods were used which, in their essence, contained serious constraints, both in their principle (non-selective quantitative scoring) as well in the way of implementation. Therefore, HUSAM has begun to develop a modern quantitative & descriptive analytical process of honey sensory analysis as well as testing of its objectivity and accuracy. Due to the expressed deficit of sufficiently trained honey assessors, HUSAM had to step into development of a system of competence assessment, screening of evaluators as well as their further education and training. This paper will present an innovative approach to the honey sensory analysis, intended for characterization and estimation of honey quality in Croatia and created by the integration of modern methodological tools. It is about establishment of novel quantitative & descriptive method of assessment of honey quality and origin, integrated in the form of a specific modularly designed IT application. Its' use provides a full range of progressive features and guidelines enabling the assessment of honey quality as well as an overview of the different peculiarities of diverse types of honey. That assures better honey valorisation on the market as well as further development of criteria that are basis for the present day honey quality definition. It is also expected better insight and correction of the oversights made during the production process (in real time), improvement of technology of honey preparation for market, as well as provision of a platform for further development of the honey assessment system.

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Analiza hrane obogaćene ribom namenjenu za ishranu radnih pasa

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Poslednjih godina postoji povećano interesovanje ka novinama u svakodnevnoj ishrani kod pasa koji imaju povećanu fizičku aktivnost, tzv. radnih pasa. Riblji proteini mogu biti dobar izbor povećanja ukupnih N-3 masnih kiselina, naročito eikozapentaenske (EPA) I dokozaheksaenske (DHA) u njihovoj svakodnevnoj ishrani.

Naš cilj bio je da analiziramo sastav hrane koji su radni psi koristili uobičajeno (1) I sastav hrane koja je bila obogaćena sa ribom (2). Sledeći cilj bio je da se radni psi hrane sa obogaćenom hranom 3 meseca I da se prate promene fizioloških parametara koje bismo ispitivali.

Analizirali smo ukupne proteine, masti, minerale I vodu u hrani 1 I 2 standarnih laboratorijskim metodama. Takođe, analizirali smo sastav masnih kiselina gasno-tečnom hromatografijom kako bismo potvrdili promene u N-3 sastavu masnih kiselina.

Rezultati su prikazani kao mean(% by weight) (SD). Rezultati su pokazali da proteinski sastav hrane 1 je bio 25.51 vs 33.31 ($p<0.05$) u odnosu na hranu 2; ukupne masti hrane 1 bile su 15.22 vs. 16.25u odnosu na hranu 2; ugljeni hidrati u hrani 1 bili su 46.41 vs 37.86 ($p<0.05$) u odnosu na hranu 2; Minerali u hrani1 bili su 7.67 vs. 8.59 u odnosu na hranu 2 dok je voda bila 5.21 in Food 1, a 4.00 u hrani 2.

Sastav masnih kisleina statistički se značajno razlikovao izmedju hrane 1 I hrane 2. Alfa-linolenska kiselina (18:3, n-3) bila je zastupljena sa 0.95 % u hrani 1 I sa 2.40% u hrani 2($p<0.001$), EPA sardžaj bio jes 0.04% in hrani 1 dok je bio 2.67% u hrani 2 ($p<0.001$); DHA sadržaj u harni 1 bio je 0.06% dok je u obogaćenoj hrani ribom bio 3.16% ($p<0.001$).

Zaključili smo da je Hrana 2 (obogaćena ribom) imala povećan sadržaj ukupnih proteina, statistički značajno manji sadržaj ugljenih hidrata kao I statistički značajno povećanje u sadržaju N-3 masnih kiselina. Ovi podaci bili su polazna osnova eksperimenta u kome bismo radne pse hranili Hranom 2 I u kome očekujemo interesantne rezultate.

Analyzed food enriched with fish for feeding working dogs

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Lately, there has been an increased interest in novelties in daily nutrition changes for dogs with increased daily physical activity, i.e. working dogs. Fish proteins could be a good source increasing overall n-3 specially (EPA) eicosapentanoic and (DHA), docosahexanoic acid in common daily food.

Our aim was to analyze the both food that working dogs were fed with before we gave them to eat enriched fish food (1), and enriched fish food (2). The second aim was to feed working dogs with Food 2 for 3 months and follow physiological changes in parameters.

We analyzed proteins, fats, minerals and water by standard laboratory methods. Also we analyzed fatty acids composition (by GC chromatography) to show the n-3 changes.

Results were expressed in mean (% by weight) (SD). Results showed that protein content in Food 1 was 25.51 vs 33.31 ($p<0.05$) in Food 2; fat content in Food 1 was 15.22 vs. 16.25 in Food 2; sugar content in Food 1 was 46.41 vs 37.86 ($p<0.05$) in Food 2; Minerals in Food 1 were 7.67 vs. 8.59 in Food2 while water content was 5.21 in Food 1 while 4.00 in Food2.

N-3 Fatty acids were statistically different in Food1 and Food 2. Alpha linoleic acid (18:3, n-3) was 0.95 % in Food1 and 2.40% in Food2 ($p<0.001$), EPA content was 0.04% in Food1 while 2.67% in Food2 ($p<0.001$); DHA content in Food1 was 0.06% while in enriched Food2 was 3.16% ($p<0.001$).

We concluded that Food2 (enriched with fish) had increased contents of proteins and statistically significant decreased in carbohydrates as well as statistically significant increase in N-3 fatty acids. Those data were the base for experiment in which working dogs will be fed with novel food and we are expecting interesting results.

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Uticaj rastvarača na apsorpcione spektre prehrambenih azo boja

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Ispitivan je uticaj rastvarača različite polarnosti na apsorpcione maksimume prehrambenih azo boja. U ovu svrhu korišćeno je šest azo boja: tartrazin (E 109), ponceau 4R (E 124), azorubin (E 122), brilijant crna (E 151), amarant (E 123) i gelboranž (E 110). Apsorpcioni spektri rastvorenih azo boja određeni su u talasnom opsegu vidljivog zračenja, odnosno od 380 do 760 nm, u osam rastvarača različite polarnosti. Izbor rastvarača je bio ograničen zbog velike polarnosti samih molekula azo boja. Spektre ispitivanih azo boja karakteriše jedan apsorpcioni maksimum. Efekat polarnosti rastvarača i efekat vodoničnog vezivanja rastvarač-rastvorena supstanca ispitivan je metodom linearne korelacije energije solvatacije (LSER), odnosno primenom Kamlet-Taftove solvatohromne jednačine. Linearna korelacija apsorpcionih maksimuma sa parametrima Kamlet-Taftove solvatohromne jednačine dala je zadovoljavajuće rezultate.

Solvent effect on the absorption spectra of food azo dye

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The effects of solvents of different polarities on the absorption maxima of food azo dyes were examined. For this purpose, six azo dyes were used: tartrazine (E 109), ponceau 4R (E 124), azorubin (E 122), brilliant black (E 151), amaranth (E 123) and gelboranz (E 110). Absorption spectra of dissolved azo dyes have been recorded in the wavelength range of visible radiation, or from 380 to 760 nm, in eight solvents of different polarities. The choice of the solvent was limited due to the high polarity of the azo dye molecules themselves. The effects of solvent dipolarity/polarizability and solvent/solute hydrogen bonding interaction were analysed by means of the linear solvation energy relationship (LSER) concept proposed by Kamlet and Taft. The linear correlation of the absorption maxima with parameters of Kamlet-Taft solvatochrome equation yielded satisfactory results

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Uticaj načina prerade grožđa i vinifikacije na sadržaj resveratrola u vinu

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U ovom radu ispitivan je uticaj enoloških zahvata i sorti grožđa na količinu resveratrola i ukupnih fenolnih jedinjenja u vinu.. Resveratrol (3,5,4'–trihidroksistilben) se javlja u dva izomerna oblika. *Trans*-izomer se nalazi u pokožici bobice većine sorti grožđa, a njegova sinteza je stimulisana UV zračenjem, povredama tkiva i gljivičnim infekcijama. *Cis*-izomer nastaje pod uticajem UV zračenja iz *trans*-izomera. Sadržaj resveratrola u vinu zavisi od mnogo različitih faktora, uključujući sortu grožđa, godinu berbe, klimatske uslove, prisustvo UV svetlosti, uslove čuvanja vina i tehnologiju proizvodnje. Viši sadržaji su obično prisutni u crvenim vinima koja su imala duži kontakt između šire i pokožice, dok su niže koncentracije u belim i roze vinima. Druge tehnološke mogućnosti za povećanje sadržaja *trans*-resveratrola u vinu su recimo, presovanje kljuka. Vina dobijena od grožđa zahvaćenog plesi *Botrytis cinerea* u meri od 80% imaju najniži nivo resveratrola, dok vina proizvedena od zdravog grožđa ili grožđa koje je zahvaćeno plesnima od 10 do 40% sadrže višu količinu resveratrola. Pored toga, koncentracija slobodnog *trans*- i *cis*-resveratrola u širi i vinu, veoma zavisi od primene različitih zahvata kao što je upotreba enzima *β*-glukozidaza. Pokazalo se da resveratrol poseduje raznovrsne biološke efekte kao što su prevencija kardiovaskularnih obolenja, antiinflamatorna i antikancerogena dejstva. Za određivanje količine resveratrola u vinu korišćena je visokoefiksana tečna hromatografija u kombinaciji sa detektorom sa diodnim nizom i RP-C_{18} kolona sa gradient eluacijom [solvent A: acetonitril - sirćetna kiselina - voda (20 : 2: 78 v/v), solvent B: acetonitril -sirćetna kiselina - voda (90 : 2 : 8 v/v)]. Detekcija *trans*- i *cis*-resveratrola izvršena je na talasnim dužinama 306 i 286 nm.

Influence the processing of grapes and vinification of resveratrol content in wine

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In this work the influence of winemaking techniques and cultivars on the resveratrol content and total phenolic content of wines was studied. Resveratrol (3,5,4'–trihydroxystilbene) exists in two isomeric forms. The *trans*-isomer occurs in the berry skins of most grape cultivars, and its synthesis is stimulated by UV light, injury, and fungal infection. *Cis*-isomer is produced by UV irradiation of the *trans*-isomer. The resveratrol content in wine depends on many different factors including variety, harvest year, climatic conditions, UV light, storage conditions and winemaking technology. Higer contens are usually present in red wines that have had prolonged contact between the must and skins, whereas lower concentrations are usally present in white and rose wines. Other winemaking conditions that influence *trans*-resveratrol content such as free- and press-run after dejuicing. Wines obtained from grapes affected 80% by *Botrytis cinerea* have the lowest resveratrol levels, while wines prepared from healthy grapes or grapes affected 10 or 40% by *Botrytis* have higher resveratrol contents. In addition, the concentrations of free *trans*- and *cis*- resveratrol in must and wines are profoundly influenced by some practices, such as the use *β*-glucosidases. Resveratrol has been shown that it possess various biological effects such as prevention of cardiovascular diseases and anti-inflammatory and anticancerogenic properties. Analyses were performed after solid-phase extraction by high-performance liquid chromatography with a diode array detection system using an RP-C_{18} with gradient elution [solvent A: acetonitrile - aceticacid - water (20 : 2 : 78 v/v), solvent B: acetonitrile - acetic acid – water 90 : 2 : 8 v/v)]. Detection of *trans*- and *cis*-resveratrol was performed on 306 and 286 nm.

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Određivanje botaničkog porekla medljikovca na osnovu odnosa stabilnih izotopa ugljenika

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Analiza stabilnih izotopa primenom masene spektrometrije odnosa izotopa kuplovane sa elementalnim analizatorom (EA-IRMS) razvijena je kao metoda za utvrđivanje autentičnosti različitih namirnica (vina, voćnih sokova, meda, itd.). Kada je u pitanju med, pored potvrde autentičnosti u pogledu načina proizvodnje (uzorci su proizvedeni od medljike, medne rose ili nektara i nema dodatog šećera) značajno je i definisanje njegovog botaničkog porekla. U ovom radu ispitana je mogućnost korišćenja odnosa stabilnih izotopa ugljenika u cilju definisanja botaničkog porekla medljikovaca. Analizirano je 66 uzoraka medljikovaca (jele, crnogorice, hrasta sladuna, primorskog hrasta i javora primorskog) sakupljenih iz nekoliko regiona u Hrvatskoj.
Potvrđeno je da $\delta^{13}C$ vrednosti proteina izolovanih iz medljikovca mogu biti pokazatelj botaničkog porekla. Izolovani proteini nose informacije o poreklu koje je karakteristično za botaničku vrstu čije su izlučevine korišćene za proizvodnju meda i oni, za razliku od meda, nemaju mogućnost falsifikovanja zbog čega su dobar marker za procenu autentičnosti.

Botanical discrimination of honeydew honey by stable carbon isotope ratio analysis

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Analysis of stable isotopes by Isotope Ratio Mass Spectrometry coupled to Elemental Analyzer has been developed for the authenticity proof of different foodstuff (wine, juice fruit, honey, etc.). In addition to the authenticity of honey according to production (the samples are produced from honeydew or nectar and have no added sugar), it is also important to define its botanical origin. In this study we examined the possibility of application of stable isotope ratio of carbon in order to define the botanical origin of honeydew honey. Total of 66 samples of honeydew honey (silver fir, conifers, Hungarian oak, evergreen oak, Montpellier maple) collected from several regions in Croatia were analysed.
It has been confirmed that the $\delta^{13}C$ values of proteins isolated from honey can be a indicator of botanical origin. Isolated proteins are a good marker for the assesment of authenticity since they carry the information on the origin that is characteristic of the botanical species whose secretions are used for honey production, and they, contrary to honey, have no possibility of adulteration.

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Sadržaj sorbitola u crvenom vinu: studija klonske selekcije sorte kaberne fran

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Cilj ovog rada bio je da se odredi sadržaj sorbitola u vinu standarda i tri klonska kandidata sorte kaberne fran (CF02, CF010 i CF012), zbog problema intolerancije kod hipersenzitivnih pojedinaca. Istaknuti klonski kandidati produkt su višegodišnjeg procesa klonske selekcije koja bi za ishod mogla da ima prve priznate klonove date sorte vinove loze na području naše države. Dobijeni rezultati u okviru ove preliminarne studije pokazali su da je uzorak vina sorte kaberne fran klonskog kandidata CF010 imao najmanji sadržaj sorbitola (5,17 mg/mL), a vina standarda najveći sadržaj ovog šećernog alkohola (12,29 mg/mL). Dalje unapređenje tehnološkog postupka moglo bi da rezultuje proizvodnjom vina sorte kaberne fran prijemčivog za osobe sa intolerancijom prema sorbitolu.

Sorbitol content in red wine: the case study of Cabernet Franc grapevine clonal selection

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The aim of this work was to determine the sorbitol content in Cabernet Franc wine samples obtained from the standard and three clone candidates (CF02, CF010 and CF012), due to the intolerance problem of hypersensitive individuals. The aforementioned clone candidates, developed within long term clonal selection, may represent the first recognised clones of this grapevine variety in our country. The lowest and highest sorbitol contents were found for the wine samples of the clone candidate CF010 and standard, 5.17 and 12.29 mg/mL, respectively. Further improvement of the applied technological procedure might result in the production of Cabernet Franc wine receptive to the people with intolerance towards sorbitol.

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Sadržaj fenolnih jedinjenja u sokovima i ekstraktima borovnice

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Borovnice su bogat izvor ugljenih hidrata, organskih kiselina, vlakana, proteina, mineralnih materija, vitamina i fenolnih jedinjenja, od kojih mnogi mogu imati antioksidativni kapacitet. Izuzetno su bogate sadržajem antocijana, proantocijanidina, flavonola, fenolnih kiselina i dr. Pored toga, borovnice poseduju hranljivu i zaštitnu ulogu, a tkođe se mogu koristi i u farmaceutskoj industriji.
Primena različitih vidova prerade borovnice može se značajno uticati na izdvajanje biološki aktivnih komponenata iz ćelija. U ovom eksperimentu sadržaj fenolnih jedinjenja ispitan je u različitim proizvodima od borovnice. Sokovi borovnice dobijeni su od svežih i zamrznutih uzoraka korišćenjem tri različita tehnološka postupka. Pored toga, vodeno-etanolni ekstrakti sušene borovnice dobijeni su postupkom jednostruke perkolacije, sa odnosom sušena borovnica:rastvarač od 1:1 i 0,5:1. Sadržaj ukupnih polifenola utvrđen je korišćenjem Follin-Ciocalteu reagensa.
Dobijeni rezultati pokazali su da je ekstrakt borovnice sa odnosom 1:1 imao najviši sadržaj ukupnih polifenola i to 13480,33 ± 49,18 mg GAE/ml. Ovaj rezultat je vrlo značajno viši u odnosu na rezultate dobijene za sokove borovnice. Međutim, došlo je takođe do značajnog povećanja sadržaja ukupnih polifenola u sokovima dobijenim od zamrznutih uzoraka u poređenju sa uzorcima dobijenim od svežeg voća. Formiranje nepravilnih kristala leda tokom smrzavanja izazvalo je oštećenje ćelija i pozitivno uticalo na ekstrakciju fenolnih jedinjenja iz biljnih ćelija nakon odmrzavanja. Najviši porast zabeležen je u sokovima dobijenim postupkom hladnog presovanja delovanjem mehaničkog pritiska na voćni kljuk.
Uopšteno, može se izvesti zaključak da sok borovnice i vodeno-etanolni ekstrakti mogu biti interesntni izvori bioaktivnih fenolnih jedinjenja u ljudskoj ishrani i pokazuju pozitivne zdravstvene efekte.

Content of phenolic compounds in blueberry juices and extracts

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Blueberries are rich source of carbohydrate, organic acids, fiber, proteins, minerals, vitamins and phenolic compounds many of which may have antioxidant capacity. They are in particular rich in the content of anthocyanins, and proanthocyanidins, flavonols, phenolic acids and others. In addition, blueberry posess nutritious, antioxidative and protective role, and also may be used in the pharmaceutical industry.
The application of different methods of blueberry processing may significantly affect the separation of biologically active compounds from the cells. In this experiment, the content of phenolic compounds has been investigated in the various blueberry products. The blueberry juices were obtained from the raw and the frozen samples by using tree different technological methods. In addition aqueous-ethanol extracts of dried blueberry was obtained by single percolation method with the ratio of dried blueberry:solvent of 1:1 and 0.5:1. The content of total phenolics was determined using the Follin-Ciocalte reagent.
The obtained results showed that the blueberry extract with the ratio of 1:1 had the highest content of total phenolics of 13480.33 ± 49.18 mg GAE/ ml. This result was very significantly higher in relation to the results obtained for the bluberry juices. However, there was also a significant increase of the total phenolics in the juices prepared from the frozen bluberies samples compared to the samples prepared from the raw fruits. The formation of irregular ice cristal during freezing, caused the cell damage and positively affected the extraction of phenolic compounds from the plant cells, after thawing. The highest increase was recorded in the juices obtained by the cold press method using mechanical pressure to the fruit pomace.
Generally, it can be concluded that blueberry juices and water-ethanolic extracts coud be an interesting sources of bioactive compound in the human diet exibited positive effects on the human health.

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Oslobađanje toksičnih elemenata iz materijala u kontaktu sa hranom

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Za pakovanje, proizvodnju, skladištenje, pripremu i posluživanje hrane koriste se različiti materijali (*Food Contact Materials*, FCMs). U kontaktu materijala sa hranom može doći do otpuštanja toksičnih elemenata i drugih metala, što utiče na bezbednost hrane. Proces migracije je rezultat kiselinsko-baznih reakcija sa površinom i pokazalo se da zavisi od različitih faktora. Glavni cilj ovog rada bio je da se istraži oslobađanja toksičnih elemenata sa površine dekorisanih tanjira od emajla u hranu i simulante. Testovi migracije su izvedeni u 4% sirćetnoj kiselini kao simulantu hrane i u tečnom jogurtu kao čestom prehrambenom proizvodu. Sadržaj elemenata analiziran je indukovano spregnutom plazmom sa masenom spektrometrijom (ICP-MS) i optičko emisionom spektrometrijom (ICP-OES). U rastvorima za ispiranje pronađeni su brojni elementi i upoređeni su njihovi migracioni profili. Iako zakonodavstvo u Srbiji za FCMs utvrđuje specifične granice migracije za određene toksične elemente, ove odredbe su samo delimično u skladu sa propisima EU. Stoga, značaj ovakvih istraživanja ogleda se u razvijanju odgovarajućih metodologija koje se mogu rutinski koristiti za ispitivanje FCMs kako u laboratorijama, tako i na industrijskom nivou.

Release of toxic elements from food contact materials

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Various materials are used for food packaging, production, storage, preparation, and serving (Food Contact Materials (FCMs)). During contact of FCMs with food, a release of toxic elements and other metals may occur, largely influencing food safety. The migration process is a result of an acid-base reaction with the surface and it was shown to depend on many factors. The main goal of this study was to investigate the release of toxic elements from decorated enamel plates into food and simulants. Migration tests were performed in 4% acetic acid as food simulant and in liquid yogurt as a common foodstuff. The elemental composition was analyzed by inductively coupled plasma with mass spectrometry (ICP-MS) and optical emission spectrometry (ICP-OES). Numerous elements were found in leaching solutions and their migration profiles were compared. Although legislation in Serbia for FCMs establishes specific migration limits for some toxic elements, these regulations are only partly in line with EU regulations. Therefore, such investigations are important to develop appropriate methodologies that can be used routinely for testing FCMs in laboratories and on an industrial scale.

Effects of electron-beam irradiation on fatty acids profile of *Agaricus bisporus* Portobello

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The knowledge about the composition of mushrooms used in food has been increasing in recent years, but their high perishability leads to immediate quality losses after harvesting, which is a drawback for the distribution and marketing of the fresh product. Furthermore, mushrooms have a great popularity all over the world, but data on alternative technologies to increase their shelf life of mushrooms are insufficient. Irradiation is a technique recognized as safe and effective for conservation, and is widely used to extend the shelf life of raw foods.
This work evaluates the effects of storage time (ST) (0, 4 and 8 days) and electron-beam (EB) irradiation on fatty acids profile (characterized by GC-FID) of fresh samples of *Agaricus bisporus* Portobello. The irradiation was performed with a 10 MeV energy irradiator at doses of 1, 2 and 5 kGy.
ST and EB irradiation had a cooperative effect (*i.e.*, the interaction among factors was significant, p-value < 0.05) over fatty acids profile. Comparing each factor individually, EB had a more noticeable effect than ST; in fact, the differences among fatty acids percentages for each EB dose were significant in all cases except C18:1n9c (oleic acid), while ST had no significant effects on C12:0, C13:0, C15:0, C18:1n9c, C18:2n6t, C18:3n3, C21:0 and MUFA. Linoleic acid (C18:2n6c) was the most abundant acid (≈78%), presenting slightly higher percentages in mushrooms irradiated with 1 kGy, showing in turn a minor decrease after 8 days of storage. Palmitic acid (≈8%) and stearic acid (≈4%), were the other main fatty acids in *A. bisporus*. Despite the detected differences, mushrooms presented a similar profile either within different EB doses, as well as along ST. Nevertheless, the 4-days storage maintains the fatty acids profile in higher extent than the 8-days storage; likewise, the best EB dose resulted to be 1 kGy.

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Primena planarne hromatografije i hemometrije u ispitivanju propolisa

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Propolis (pčelinji lepak) je lepljiva prirodna supstanca koja se dobija tako što pčele radilice (*Apis mellifera* L.) prikupljaju smole sa pupoljaka i mešaju ih sa voskom. Propolis ima složen hemijski sastav i sadrži preko 420 različitih jedinjenja. Propolis je izgrađen od biljne smole (50%), voska (30%), esencijalnih ulja (10%), polena (5%) i ostalih organskih supstanci (5%). Propolis pokazuje širok spektar bioloških svojstava kao što su antimikrobno, antioksidativno, antiinflamatorno, imunostimulatorno, antikancerogeno. U našim prethodnim istraživanjima, ispitivali smo fenolni profil i botaničko poreklo propolisa primenom HPTLC metoda. Dobijeni rezultati potvrđuju prisustvo oranž i plavog tipa propolisa.
U ovoj studiji ispitivan je fenolni profil geografski i botanički različitih uzoraka propolisa primenom planarne hromatografije u kombinaciji sa hemometrijom. Različite hemometrijske tehnike primenjene su za klasifikaciju botanički i geografski različitih uzoraka propolisa. Takođe, tehnike pred-procesuiranja kao što su uklanjanje šumova, procedura savijanja, normiranje, skaliranje i centriranje su primenjene u cilju pobojšanja multivarijantnog modela. Kombinacija planarne hromatografije sa hemometrijom pokazala se kao precizna i pouzdana metoda za kontrolu kvaliteta propolisa. Multivarijantna analiza omogućava dobijanje informacija koje se odnose na sličnosti/razlike između uzoraka, identifikaciju karakterističnih, kao i bioaktivnih jedinjenja.

Application of planar chromatography and chemometrics in investigation of propolis

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Propolis is a resinous substance collected by honey bees (*Apis mellifera*) from exudates and buds of the plants and mixed with wax. It is a complex mixture of more than 420 compounds and contains resin (50%), honey bees wax (30%), etheric oils (10 %), pollen (5%), and other organic substances (5%). Several biological properties have been attributed to phenolic compounds from propolis, mainly antibacterial, antiviral, antifungal, anti-inflammatory, and antioxidant. In our previous reports, according to HPTLC fingerprint, we confirmed presence of two botanically different subtypes of European propolis.
In the current study, we investigated phenolic profile of propolis samples using planar chromatography in combination with chemometrics. To date, different chemometric methods were applied for classification of geographically and botanical different propolis samples. Also, the influence of different pre-processing methods such as denoising/smoothing, warping, normalization and scaling/centering were investigated to improve multivariate models. The combination of planar chromatography with chemometrics was proven to be an accurate and reliable tool for quality control of geographical and botanical different propolis samples. Multivariate analysis allows extracting the full information from HPTLC chromatograms such as similarity/dissimilarity between samples, identification of characteristic marker compounds as well as prediction of bioactive compounds.

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Sigurnost hrane – stanje i prognoze

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Za obezbeđivanje dovoljnih količina hrane koristi se termin sigurnost hrane, koji se definiše kao: „Kada svi ljudi, u svakom vremenu, mogu fizički i ekonomski da imaju dovoljno hrane, bezbedne i nutritivno vredne, koja može da zadovolji njihove potrebe, da bude prihvatljiva i da im omogućava uobičajne aktivnosti i zdrav život“. Sigurnosti hrane doprinose njena raspoloživost, pristupačnost, stabilnost, energetska i nutritivna vrednost, podmirenje potreba za vodom u proizvodnji, degradacija zemljišta, klimatske promene, bolesti biljaka, odnosno životinja, politički odnosi, porast populacije, energetska potrošnja, homogenizacija potrošnje, formiranje cena, smanjenje količine bačene hrane. O sigurnosti hrane, njenoj potrošnji, potrebama za svetsku populaciju brinu međunarodne organizacije (UN, FAO, WHO). Na nacionalnom nivou, o sigurnosti hrane brinu vlade, resorna ministarstva, komore, različita udruženja itd. Prema FAO podacima u svetu je hronično podhranjeno 870 miliona ljudi (12,5 posto svetske populacije), a od gladi umire 6 miliona dece starosti do 5 godina za godinu dana. Smanjanje broja podhranjenog stanovništva kao i smrtnost od gladi mogla bi znatno da se smanji smanjenjem količine bačene hrane i povećanjem poljoprivredne proizvodnje. Sigurnost hrane najčešće se dovodi u vezu sa porastom svetske populacije (2050 godine 9,7 milijardi). Prvu podrobniju analizu odnosa promene broja populacije i proizvodnje hrane dao je Tomas Maltus (1776-1834 godine) koji je upozorio svet na mogućnost pojave gladi polovinom 19. veka. Njegova predviđanja i predviđanja njegovih kasnijih sledbenika nisu se obistinila. Prognoze o mogućnostima proizvodnje dovoljnih količina hrane u budućnosti su optimistične i mogu se smatrati realnim uz uslov da se poljoprivredna proizvodnja u oba svoja sektora (biljna i animalna) unapređuje, a da pri tom ima što manje uticaj na životnu sredinu (održivi razvoj).

Food security – current situation and predictions

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We use term food security when we talk about poviding enough food for world population. It is defined as: „when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". For food security, basic contribution are given by its avaiability, accessibility, stability, energy and nutritional value, support for needs of water in production proceses, land degradation, climate change, deseases of plants, or animals, political relations, increase in population, energy consumption, homogenization of consumption, price formation, reduced amount of thrown food. International organization (UN, FAO, WHO) concern about food security, its use, as well as of the world population needs. On national level, Governments, Ministries, various association etc. taking care about food security and its policy. According to FAO's data, in the world is chronicaly malnourished 870 million people (12,5% of the world population) starve, and dies six million children aged up to 5, per year. The reduction of malnourishe population, as well as mortality, could be significantly reduced with amount of thrown food and increasing agricultural production. Food security is most commonly linked with the rise of the world population (in 2050 it will be 9,7 billion). The first detalied analysis of the relation between changes in population and food, was given by Thomas Malthus (1776-1834), who was warned of the possibillity of famine, in the mid of 19th century. He and his followers predicition did not come true. Prediciton about capabilities of producing sufficient quantities of food in the future are optimistic and may be considered as real, if agriculture production in both sectors (plant and animal) impoves, with minimal harmfull impact on environment (sustainable development).

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Antioksidativni potencijal osam sorti krušaka iz Srbije

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Centralni i jugozapadni deo Srbije se karakteriše velikom raznovrsnošću autohtonih sorti krušaka (*Pyrus communis* L.) koje se gaje stotinama godina, a koje su od značaja kao genetski resurs, ali i kao tradicionalna hrana i lekovito sredstvo. Ova studija istražuje antioksidativni potencijal metanolnih ekstrakata kore i mesa plodova krušaka iz centralne i jugozapadne Srbije, koji su prikupljeni u periodu jul-septembar 2016. Prikupljeni su plodovi sedam autohtonih sorti i jedne komercijalne sorte. Kora i sočni deo ploda (meso) ekstrahovani su pomoću 70% metanola da bi se dobili sirovi ekstrakti. Antioksidativna aktivnost, testirana DPPH, ABTS i FRAP metodom, i ukupan sadržaj fenola i flavonoida izmereni su spektrofotometrijski. Metanolni ekstrakti kore pokazali su veću DPPH aktivnost (3,45-52,15 µg/mL) u odnosu na meso ploda (7,35-318,39 µg/mL). U ABTS testu je pokazana jača aktivnost kore (1,1-2,78 mg AAE/g) u odnosu na meso ploda (0,26-1,22 mg AAE/g). Takođe, veći FRAP kapacitet je dobijen za ekstrakte kore (665-1641 µmol Fe(II)/g) u odnosu na meso (179-912 µmol Fe(II)/g). Ekstrakt kore pokazao je veći sadržaj fenola (141-2414 mg GAE/g), kao i veći sadržaj flavonoida (14-99 mg QE/g) u odnosu na meso ploda (37-795 mg GAE/g, odnosno 7-30 mg QE/g). Najveći antioksidativni potencijal pokazali su ekstrakti plodova krušaka *takiša* i *vodenjača,* dok je komercijalna sorta *viljamovka* pokazala najmanju aktivnost. Zapažena je pozitivna korelacija između antioksidativne aktivnosti ekstrakata kore i visokog sadržaja fenola u kori. Ovo istraživanje pokazuje da bi autohtone sorte krušaka sa teritorije Srbije mogle da se koriste ne samo kao tradicionalna zdrava hrana, već i kao značajan resurs bioaktivnih supstanci koje pozitivno utiču na zdravlje.

Antioxidant potential of eight pear varieties growing in Serbia

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The great diversity of indigenous varieties of pear (*Pyrus communis* L.) in central and southwest Serbia, which have been cultivated for hundreds of years, is recognized as a significant source of gene pool, as well as healthy food and traditional remedy. This study was aimed to determine the antioxidant potential of methanolic extracts of peel and flesh of pear fruits from Serbia. Fruits of seven traditional and one commercial pear varietiy were collected in southwest and central Serbia during July-September 2016. Peel and flesh were subjected to extraction with methanol to obtain crude extracts. Antioxidant activity of extracts was evaluated using DPPH, ABTS and FRAP assays, and total phenolic and flavonoid contents were determined spectrophotometrically. The extracts were tested at concentrations of 25 µg/mL for DPPH, FRAP assays and flavonoid content, and 2.5 µg/mL for ABTS assay and phenolic content. The methanol extracts of peel showed higher DPPH activity (3.45-52.15 µg/mL) comparing to flesh (7.35-318.39 µg/mL). ABTS test showed stronger activity of peel (1.1 mg AAE/g -2.78 mg AAE/g) comparing to flesh (0.26 mg AAE/g -1.22 mg AAE/g). Similarly, higher FRAP capacity was obtained for peel (665-1641 µmol Fe(II)/g) comparing to flesh (179-912 µmol Fe(II)/g). The peel extracts showed higher phenolic (141-2414 mg GAE/g) and flavonoid (14 mg-99 mg QE/g) contents comparing to flesh (37-795 mg GAE/g and 7-30 mg QE/g, respectively). The high antioxidant potential was shown by *takiša* and *vodenjača* pear varieties, while commercial *viljamovka* variety exhibited the lowest activity. Better antioxidant activity of peel extracts could be correlated to high phenolic content. The presented findings indicate that indigenous varieties of pear fruits can be exploited as healthy natural food, and as potential source of natural bioactive compounds.

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BKHP65 / FQSP65

Određivanje mineralnog sadržaja začina primenom ICP-OES metode

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Začini predstavljaju sve jestive delove biljaka koji se koriste za aromatiziranje ili bojenje hrane, uključujući plod, koren, seme, koru ili samu biljku. Upotreba začina se značajno razlikuje u drugim kulturama i zemljama; koriste se u medicini, verskim ritualima, kozmetici, parfimeriji i hrani. Začini se uglavnom koriste kao preventiva protiv štetnih bakterija ili kao izvori nutritijenata koji su važni za ljudsko zdravlje. U ovoj studiji istraživan je sadržaj Ag, Al, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, In, K, Li, Mg, Mn, Na, Ni, Pb, Sr, Tl i Zn u deset uzoraka začina koji su pronađeni na tržištu u Leskovcu. Analizirani začini su kurkuma, zvezdasti anis, cimet, đumbir, korijander, kardamon, susam, crni biber, čili i kari. Uzorci su pripremljeni mokrom digestijom. Koncentracije minerala nakon digestije su određene primenom optičke emisione spektrometrije sa indukovano spregnutom plazmom (ICP-OES). U svim uzorcima, koncentracija kalcijuma je bila najveća (18.225 – 59.252 mg/g). Od svih ispitivanih teških metala (bakar, cink, mangan, nikal, kadmijum i olovo) koji su određivani u ispitivanim uzorcima, najprisutniji je bio mangan u opsegu od 0.007 do 0.625 mg/g, dok su nikal i kadmijum detektovani u zanemarljivim koncentracijama.

Determination of mineral content of spices by ICP-OES

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Spices represent all edible parts of plant that used for flavoring or coloring foods, including fruit, root, seed, bark or vegetable substance. The use of spices is significanly different among cultures and countries; they are used in medicine, religious rituals, cosmetics, perfumery and in foods. Species are mainly used as a preventive against harmful bacteria or as sources of nutrients that are important for human health. In this study we have investigated content of Ag, Al, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, In, K, Li, Mg, Mn, Na, Ni, Pb, Sr, Tl and Zn in ten spice samples, that were found in local markets on Leskovac territory. Analysed spices were curcuma, star anise, cinnamon, ginger, coriander, cardamom, sesame, black pepper, chilli and curry. Preparation of samples was done by wet digestion. Concentrations of elements after digestion were determined by Inductively Coupled Plasma – Optical Emission Spectrometry (ICP-OES). In all samples, the concentration of calcium was the biggest (18.225 – 59.252 mg/g). Of all heavy metals (copper, zinc, manganese, nickel, cadmium, and lead) examined in investigated sampes, the most present was manganese in the range of 0.007 to 0.625 mg/g, while nickel and cadmium were detected in negligible amounts.

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Antifungal activity of *Eugenia caryophillata* Thun., *Cinnamomum zeylanicum* Blume and *Carum carvi* L. essential oils using resazurin based microdilution method

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Clove (*Eugenia caryophillata* syn. *Syzygium aromaticum)*, cinnamon (*Cinnamomum zeylanicum*) and caraway (*Carum carvi*) have a long tradition of use as flavor ingredients in foods and beverages. Antifungal activity of their essential oils (EOs) had been evaluated against eight selected airborne fungal isolates of genera *Aspergillus* and *Penicillium* which are common food contaminants and spoilage fungi. To determine minimal inhibitory (MICs) and minimal fungicidal concentrations (MFCs) microdulution assay based on redox indicator resazurine was employed. Nistatin solution (10 µl ml^{-1}) was used as a positive control. MIC values ranged from 0.5 to 10 µl ml^{-1} for clove, 0.5 to 1 µl ml^{-1} for cinnamon and 0.5 to above 10 µl ml^{-1} for caraway EOs. Likewise, MFC values ranged from 1 to above 10 µl ml^{-1} for clove EO, 1 to 10 µl ml^{-1} for cinnamon while all values were above 10 µl ml^{-1} for caraway. The results demonstrated the strongest antifungal activity for cinnamon EO and weakest for caraway (MFCs were not documented). *A. flavus* was found to be the most resistant isolate, where no MFC values were obtained in any of the tested substances except in cinnamon EO in which MFC was relatively high (10 µl ml^{-1}). The most susceptible isolate was *P. carneum*, exhibiting MIC value as low as 0.5 µl ml^{-1} in all tested EOs. This species is typically associated with meat products, beverages, and bread spoilage and produces patulin. Furthermore, all tested EOs exhibited stronger antifungal activity compared to nistatine, where all obtained MIC and MFC values were above 10 µl ml^{-1}. Resazurin based microdilution method presents a rapid and unambiguous test for determination of MIC and MFC values of EOs and other antifungals.

Antifungalana aktivnost etarskih ulja *Eugenia caryophillata* Thun., *Cinnamomum zeylanicum* Blume i *Carum carvi* L. primenom mikrodilucione metode i resazurina

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Karanfilić (*Eugenia caryophillata* syn. *Syzygium aromaticum)*, cimet (*Cinnamomum zeylanicum*) i kim (*Carum carvi*) imaju dugu tradiciju korišćenja kao začinske biljke, tj. kao dodaci različitoj hrani i napicima. Ispitivana je antifungalna aktivnost etarskih ulja pomenutih biljaka na osam odabranih vrsta rodova *Aspergillus* i *Penicillium*, poznatih kontaminanata i uzročnika kvarenja hrane. Pomoću mikrodilucione metode i dodavanja redoks indikatora resazurina, utvrđene su minimalne inhibitorne (MIK) i minimalne fungicidne koncentracije (MFK). Rastvor nistatina (10 µl ml^{-1}) je korišćen kao pozitivna kontrola. MIK vrednosti etarskog ulja karanfilića su bile u opsegu od 0,5 do 10 µl ml^{-1}, etarskog ulja cimeta od 0,5 do 1 µl ml^{-1} i etarskog ulja kima od 0,5 do iznad 10 µl ml^{-1}. Isto tako, MFK vrednosti etarskog ulja karanfilića su bile u opsegu od 1 do preko 10 µl ml^{-1}, etarskog ulja cimeta od 1 do 10 µl ml^{-1}, dok su za etarsko ulje kima sve dobijene vrednosti bile preko 10 µl ml^{-1}. Najjača antifungalna aktivnost je zabeležena za etarsko ulje cimeta a najslabija za etarsko ulje kima, gde nisu dokumentovane MFK vrednosti. Najrezistentniji izolat bio je *A. flavus*, za koga nisu dobijene MFK vrednosti u ispitivanom opsegu osim za cimetovo ulje kod koga je zabeležena relativno visoka MFK vrednost (10 µl ml^{-1}). Najosetljiviji izolat bio je *P. carneum*, za koga je dokumentovana MIK vrednost 0.5 µl ml^{-1} kod svih testiranih etarskih ulja. Ova vrsta se često izoluje iz mesnih proizvoda, napitaka i izaziva buđanje hleba. Takođe je producent mikotoksina patuilna. Za sva etarska ulja je pokazana jača antifungalna aktivnost u poređenju sa nistatinom, gde su sve dobijene MIK i MFK vrednosti bile iznad 10 µl ml^{-1}. Mikrodiluciona metoda sa dodatkom resazurina predstavlja brz i precizan test za utvrđivanje MIK i MFK vrednosti etarskih ulja ali i drugih antifungalnih agenasa.

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Identifikacija jedinjenja odgovornog za izraženu antibakterijsku aktivnost ekstrakata *Cistus creticus* subsp. *creticus*

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Cistus creticus subsp. *creticus* (familija Cistaceae) je žbunasta mediteranska biljka koja se upotrebljava kako u proizvodnji sapuna i parfema, tako i u prehrambenoj industriji kao komercijalni pojačivač ukusa hrane. Zahvaljujući prisustvu različitih tipova sekundarnih metabolita kao što su terpenoidi (prvenstveno diterpenoidi labdanskog tipa), polifenoli i flavonoidi, ekstrakti *C. creticus* pokazuju i brojne farmakološke efekte.

U okviru ovog istraživanja utvrđivana je antimikrobna aktivnost uzoraka smole i ekstrakata izdanaka biljaka *C. creticus* gajenih u kulturi *in vitro* (IV) i u stakleniku (GH). Svi uzorci su pokazali snažnu antibakterijsku aktivnost prema svim ispitivanim vrstama. Minimalne inhibitorne koncentracije (MIK) uzoraka izdanaka i smole *C. creticus* bile su u opsegu od 0,003-0,04 mg/ml, dok su minimalne baktericidne koncentracije (MBK) bile u rasponu od 0,005-0,08 mg/ml. Dodatno je korišćen bioautografski test na TLC pločama za analizu antimikrobne aktivnosti razdvajanjem komponenata u cilju određivanja jedinjenja sa najvećom bioaktivnošću. U uzorku smole detektovana je značajna zona inhibicije, koju je pokazalo visoko aktivno jedinjenje sa Rf vrednostima od 0.45. Ova zona inhibicije je dalje prečišćena preparativnom TLC hromatografijom, a potom je urađena NMR analiza dobijene komponente. NMR rezultati su ukazali na prisustvo *ent*-3*β*-*acetoksi*-13-*epi*-manoil oksida koji bi se mogao smatrati odgovornim za značajnu antibakterijsku aktivnost smole. Ovo bioaktivno jedinjenje je zastupljeno u većem procentu u uzorku smole nego u uzorcima izdanaka biljaka *C. creticus* prema rezultatima dobijenim GC/FID i GC/MS analizom. Dalja istraživanja će biti fokusirana na biotehnološku proizvodnju ovog specifičnog fitohemijskog jedinjenja.

Identification of compound responsible for the prominent antibacterial activity of *Cistus creticus* subsp. *creticus* extracts

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Cistus creticus subsp. *creticus* (family Cistaceae) is a shrubby Mediterranean plant, which is used in soaps, perfumery, and in food industry as flavouring agent. Numerous pharmacological effects of *C. creticus* extracts come from the presence of different types of secondary metabolites such as terpenoids (predominantly labdane type diterpenoids), polyphenols and flavonoids.

In this communication, samples of resin and extracts isolated from *C. creticus* shoots grown *in vitro* (IV) and in greenhouse (GH) were tested for their antimicrobial activity. All the samples showed strong antibacterial activity against all the species tested. MICs (minimum inhibitory concentrations) of shoots and resin samples of *C. creticus* were in the range of 0.003-0.04 mg/ml, while recorded MBCs (minimum bactericidal concentrations) were in the range of 0.005-0.08 mg/ml. Additionally, the bioautographic assay on TLC plates was used to screen for antimicrobial activity by separating components in order to determine the most bioactive ones. The resin sample exhibited one significant zone of inhibition, which corresponded to a highly active compound with Rf values of 0.45. This zone was further purified by preparative TLC followed by NMR analyses, which indicated *ent*-3*β*-acetoxy-13-*epi*-manoyl oxide as the component exhibiting the most prominent antibacterial activity in the resin. GC/FID and GC/MS analyses suggested that this bioactive compound is present in higher percentage in sample of resin than in samples of *C. creticus* shoots. Our future research will focus on biotechnological production of this promising phytochemical.

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Poređenje antimikrobne aktivnosti ekstrakta biljke *Arthemisia absinthium* (pelin) sa aktivnošću komercijalnih likera

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Arthemisia absinthium L., pelin, je višegodišnja žbunasta biljka sa brojnim lekovitim svojstvima. Pelinkovac je naziv za likere sa 28% alkohola, nazvane tako po pelinu koji im daje aromu. Ispitani su likeri Pelinkovac (Slatka kuća, Kragujevac, Srbija - SK) i Gorki List (Neodoljivo bilje, Subotica, Srbija - GL). Kako bi utvrdili da li dodatno dodavanje pelina u likere može povećati njihovo korisno dejstvo, mikrodilucionom metodom je ispitana njihova antimikrobna aktivnost i poređena sa rastvorom pelina u 28% etanolu (PE). Korišćeni su mikroorganizmi izolovani iz usne duplje pacijenata, gljive *C. albicans*, *C. glabrata* i *C. krusei* i bakterije *S. pyogenes* i *E. faecalis*. Najbolju antifungalnu aktivnost je pokazao PE sa minimalnom inhibitornom koncentracijom (MIK) 0.17 mg/mL. Likeri su imali sličnu antifungalnu aktivnost sa MIK (4.19–17.32 mg/mL). Najosetljiviji je bio klinički izolat *C. glabrata*, potom sojevi *C. albicans* (3 klinička izolata i jedan referentni soj *C. albicans* ATCC 10231), dok je najotporniji bio *C. krusei* (2 klinička izolata). Najbolju antibakterijsku aktivnost ispoljio je PE (MIK 0.34-1.36 mg/mL), a soj *E. faecalis* je bio osetljiviji od *S. pyogenes*. U sprečavanju formiranja biofilma *C. albicans* najefikasniji je SK (48.2% inhibicije), GL (43.6%), PE (26.4%). Formiranje biofilma *E. faecalis* bilo je redukovano za 86.0% sa SK, 74.6% (GL), odnosno 13.6% sa PE. Biofilm *S. spyogenes* je bio rezistentniji, GL nije sprečio njegovo formiranje, SK je sprečio za 10.3% dok ga je PE redukovao za 74.5%. Oba likera mogu da spreče rast ispitanih mikroorganizama *in vitro*, ali je SK bolji u sprečavanju njihovog grupisanja, te bi se unapređivanju njegovog sadržaja moglo doprineti, naročito dodavanjem pelina koji se pokazao kao jak antimikrobni agens.

Comparison of antimicrobial potential of *Arthemisia absinthium* (wormwood) extract with the activity of commercial liqueurs with wormwood flavor

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Arthemisia absinthium L., wormwood, is perennial bushy plant known for various health benefits. Pelinkovci is Serbian name for the liqueurs with 28% alcohol that contain wormwood (pelin) as aromatic constituent. The study examined two commercial liqueurs: Pelinkovac (Slatka kuća, Kragujevac, Serbia – PE) and Gorki list (Neodoljivo bilje, Subotica, Srbija - GL). In order to determine if addition of plant extract could increase beneficial effects of these strong drinks, microdilution method was used to examine their antimicrobial activity which has been compared with the activity of wormwood extract dissolved in 28% ethanol (PE). Microorganisms, pathogens isolated from oral cavity, were tested (fungi *Candida albicans*, *Candida glabrata* and *Candida krusei* as well as bacteria *Streptococcus pyogenes* and *Enterococcus faecalis*). Highest antifungal potential was observed for PE with minimal inhibitory concentration (MIC) 0.17 mg/mL. Liqueurs had similar antifungal activity with MIC in range 4.19–17.32 mg/mL. *C. glabrata* clinical isolate was the most sensitive followed by strains of *C. albicans* (3 clinical isolates and one reference strain *C. albicans* ATCC 10231), while *C. krusei* was the most resistant to antimicrobial treatment. Highest antibacterial activity was observed for PE (MIC 0.34-1.36 mg/mL), with *E. faecalis* strain being more sensitive than *S. pyogenes*. Best activity in preventing *C. albicans* biofilm formation was observed for SK (48.2% inhibition), GL (43.6%), PE (26.4%). Formation of *E. faecalis* biofilm was inhibited for 86.0% with SK, 74.6% GL, 13.6% PE. Biofilm formed by *S. pyogenes* was more resistant and GL could not prevent it from establishing, while SK prevented it for 10.3%. PE had highest preventing ability since it inhibited *S. pyogenes* biofilm formation for 74.5%. Both liqueurs are able to prevent growth of tested pathogenic microorganisms *in vitro*, but SK had better potential in prevention of grouping into biofilm, indicating that we could further work on development of this drink, possibly through addition of more wormwood since it has been proven as strong antimicrobial agent.

BKHP69 / FQSP69

Analiza fizičko-hemijskih osobina i antioksidativne aktivnosti različitih uzorka meda iz Centralne Srbije

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Med je nektar koji sakupljaju medonosne pčele (*Apis mellifera*) sa različitih biljaka.[1] Poznato je da med sadrži oko 200 komponenti (kompleksne mešavine šećera, ali takođe i manje količine drugih konstituenata kao što su minerali, proteini, organske kiseline, flavonoidi, fenolne kiseline, enzimi i druga jedinjenja biljaka) tako da predstavlja važan deo tradicionalne medicine.[2] Zbog ogromnih benefita meda za ljudsko zdravlje cilj ovog rada je bio da se ispitaju fizičko-hemijske osobine (boja, pH i slobodna kiselost, sadržaj vlage i električna provodljivost), sadžaj fenolnih jedinjenja i antioksidativna aktivnost tri različite vrste meda iz Centralne Srbije. Uzorci meda koji su korišćeni u ovom istraživanju potiču od sledećih izvora: šumski med (crni ćilibar), livadski med (ekstra proziran) i bagremov med (vodeno proziran). Svi uzorci su sakupljeni tokom sezone 2018. godine i obezbeđeni su od lokalnog pčelara iz Šumadije. Spektrofotometrijskim određivanjem vodenih ekstrakata meda utvrđeno je da šumski med poseduje deset puta veći sadržaj ukupnih fenolnih jedinjenja (806,10 mg GKE/kg) i flavonoida (146,27 mg KVE/kg) od bagremovog meda (68,48 mg GKE/kg za ukupna fenolna jedinjenja i 18,59 mg KVE/kg za ukupne flavonoide). Antioksidativni potencijal meda određen je $ABTS^{+\cdot}$ i $DPPH^{\cdot}$ metodama. Šumski med je pokazao veću antioksidativnu aktivnost od drugih uzoraka meda (594,77 mg Troloksa/kg za ABTS and 260,77 mg Troloksa/kg za DPPH metodu). Ovim istraživanjem je utvrđena veza između boje, fenolnog sadržaja i antioksidativnog kapaciteta uzoraka meda. Šumski med sadrži najviše fenolnih jedinjenja, ima najveću električnu provodljivost (što ukazuje na veći sadržaj minerala) i antioksidativnu aktivnost. Dobijeni rezultati sugerišu da od ispitivanih uzoraka šumski (crni) med ima najbolji potencijal za korišćenje u ljudskoj ishrani kao hrana značajne biološke vrednosti.

Comperative analysis of physico-chemical properties and antioxidant activity of different simples of honey from Central Serbia

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Honey is nectar collected from many plants and processed by honey bees (*Apis mellifera*).[1] Honey has been reported to contain about 200 substances (complex mixture of sugars, but also small amounts of other constituents such as minerals, proteins, vitamins, organic acids, flavonoids, phenolic acids, enzymes and other phytochemicals) and it is an important part of traditional medicine.[2] Considering many benefits of honey for human health the aim of this study was to determine physico-chemical properties (colour, pH and free acidity, moisture and electrical conductivity), to examine the phenolic content and antioxidant activity of the three different simples of honey from Central Serbia. Honey samples used in this study came from the following sources: forest honey (Dark amber), meadow honey (Extra white) and monofloral acacia honey (Water white). All simples were provided by local beekeeper from Šumadija district and collected during the flowering season 2018. Spectrophotometric determination of honey water extracts has shown that the forest honey contained total phenolic compounds (806.10 mg GAE/kg) and flavonoids (146.27 mg QU/kg) content more than ten times higher than acacia honey (68.48 mg GAE/kg and 18.59 mg QU/kg, respectively). Antioxidant activity was determined by $DPPH^{\cdot}$ and $ABTS^{+\cdot}$ methods. Forest honey showed better antioxidant activity then the other honey simples (594.77 mg Trolox/kg for ABTS assay and 260.77 mg Trolox/kg for DPPH assay) in applied assays. The present study established a correlation between the colour and phenolic contents, and antioxidant capacity of the honey samples evaluated. Forest honey had the highest amounts of phenolic compounds, electrical conductivity (high mineral content) and antioxidant activity. These results suggest that forest honey (Dark amber) has the best potential among studied honey samples for using in human diet as food with valuable biological value.

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BEZBEDNOST I KVALITET HRANA / FOOD QUALITY AND SAFETY

BKHP70 / FQSP70

Ispitivanje profila flavan-3-ola grožđa i vina autohtonih sorti vinove loze primenom tankoslojne hromatografije

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Flavan-3-oli pripadaju grupi flavonoida i prevashodno se nalaze u semenkama grožđa i pokožici, dok se u mezokarpu mogu pronaći u manjim količinama. U ovom radu ispitan je profil flavan-3-ola različitih autohtonih sorti grožđa i odgovarajućih vina primenom tankoslojne hromatografije. Razdvajanje flavan-3-ola postugnuto je na silika-gelu uz upotrebu mobilne faze toluen/aceton/mravlja kiselina. Vizuelizacija zona flavanola izvršena je pomoću rastvora *p*-dimetilaminocinamaldehid (*DMACA* reagens). Dobijeni rezultati predstavljaju profil (hemijski „otisak prsta“) flavan-3-ola pojedinačnih delova bobice i odgovarajućih vina. U svim ispitivanim uzorcima semenki dokazano je prisustvo (+) katehina, a na osnovu hromatograma utvrđen je sličan profil flavan-3-ola. Različiti inteziteti zona ukazali su na razliku u sadržaju pojedinačnih flavanola među sortama. U pokožicama belih sorti pronađen je nešto veći sadržaj flavan-3-ola u odnosu na pokožice crnih sorti. U slučaju sortnih vina, profili su bili bogatiji flavan-3-olima u poređenju sa pokožicama, ali su u odnosu na semenke, zone bile slabijeg intenziteta.

Flavan-3-ol profiles of autochthonous grapes and wines investigated by thin-layer chromatography

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Flavan-3-ols belong to the group of flavonoids and they are located primarily in the grape seeds, then in the skins and, in small amounts, in the pulp. In this work flavan-3-ol profiles of diverse autochthonous grape varieties and corresponding wines were investigated by thin-layer chromatography (TLC). Separation of flavanols was done on silica gel TLC plates with toluene/acetone/formic acid mixture as mobile phase. Plates were derivatised with *p*-dimethylaminocinamaldehyde reagent (DMACA) as visualization solution. As a result, flavan-3-ol profiles (chemical fingerprints) of individual parts of berries and corresponding wines were obtained. The similar flavan-3-ol profiles were established in all examined seed samples. Also, (+) catechin was found in all investigated seed extracts. However, different intensity of the zones indicated differences in the content of individual flavanols among the varieties. A slightly larger content of flavan-3-ol was found in skin extracts of white varieties compared to red ones. In the case of wines, the profiles were richer in flavan-3-ols in comparison to skins, but the intensity of zones was lower than intensity obtained for seed extracts.

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Енолошки параметри у карактеризацији вина: студија клонске селекције сорте каберне фран

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Циљ овог рада био је одређивање енолошких параметара четири узорка вина (стандард и три клонска кандидата /02, 010 и 012/) сорте каберне фран пореком из Републике Србије (узгајане на Пољопривредном огледном добру "Радмиловац" у Београду), припремљена под истим условима. Међу 13 одређених параметара (који укључују укупне и испарљиве киселине, pH, пепео, укупни екстракт, садржај алкохола, редукујуће шећере, алдехиде, естре и танине) посебна пажња на постерској презентацији биће посвећена садржају неиспарљивих органских киселина, тј. винске, јабучне, сирћетне, лимунске и млечне киселине.

Enological parameters in wine characterisation: The case study of Cabernet Franc clonal selection

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The aim of this study was to determinate a number of enological parameters of four samples (standard and three clone candidates /Nos. 02, 010 and 012/) of Cabernet Franc wines from the Republic of Serbia (grown at the agricultural experimental field "Radmilovac" in Belgrade), prepared under the same conditions. Among 13 tested parameters (which include both total and volatile acids, pH, ash, total extract, alcohol content, reducing sugars, aldehydes, esters and tannins) particular attention in the poster presentation will be given to the content of nonvolatile organic acids, i.e. to tartaric, malic, acetic, citric and lactic acids.

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Uvid u kvalitativni polifenolni profil novih vina sorte kaberne fran

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Cilj ovog rada bio je određivanje polifenolnog profila četiri uzorka vina (standard i tri klonska kandidata /02, 010 i 012/) sorte kaberne fran porekom iz Srbije (Radmilovac, Beograd), pripremljena pod istim uslovima. Primenjena je ultra visoko-efikasna tečna hromatografija (UHPLC) sa masenim detektorom visoke rezolucije (LTQ OrbiTrap XL). Analizom LC/MS datih uzoraka vina identifikovana su ukupno 54 polifenola, konkretno, 13 fenolnih kiselina i njihovih derivata, 18 derivata flavan-3-ola, 10 stilbenoida i 13 flavonoida, dok je prisustvo 18 jedinjenja potvrđeno pomoću analitičkih standarda. Ostala jedinjenja identifikovana su na osnovu tačne mase molekulskog jona $[M-H]^-$ i njegove fragmentacije MS^2, MS^3 i MS^4, poređenjem sa dostupnim literaturnim podacima.

An insight into the qualitative polyhenolic profile of novel Cabernet Franc wines

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The aim of this study was to afford a detailed polyphenolic profile of four samples (standard and three clone candidates /Nos. 02, 010 and 012/) of Cabernet Franc wines from Serbia (Radmilovac, Belgrade), prepared under the same conditions. Ultra High Performance Liquid Chromatography (UHPLC) with a high resolution mass spectrometry detector (LTQ OrbiTrap XL) was applied. LC/MS analysis of these wine samples revealed a total of 54 polyphenolics, namely, 13 phenolic acids and their derivatives, 18 flavan-3-ol derivatives, 10 stilbenoids and 13 flavonoids. While the presence of 18 compounds was confirmed using analytical standards. The rest of them was identified by the exact masses of their deprotonated molecules $[M-H]^-$ followed by MS^2, MS^3 and MS^4 fragmentations, compared with the available literature data.

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BKHP73 / FQSP73

Razlikovanje uzoraka meda na bazi botaničkog porekla primenom fluorescentne spektroskopije, diferencijalne skenirajuće kalorimetrije i HPLC-PAD

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Fluorescentna spektroskopija u kombinaciji sa hemometrijom je korišćena za razlikovanje uzoraka meda prema njihovom botaničkom poreklu. Emisioni spektri dve monofloralne (lipa i bagrem) i polifloralne (livadski sa primesom suncokreta) vrste meda prikupljeni su u opsegu ekscitacije od 300-550nm, nakon pobuđivanja od 270 nm do 380 nm, sa korakom od 5 nm. Hemometrijska analiza prikupljenih podataka uključivala je Analizu Glavne Komponente (PCA) i algoritam Multivarijaciono Razlaganje Krivih (MCR-ALS). Po prvi put je korišćen odnos proteinske i fenolne komponente u emisionim spektrima meda za razlikovanje uzoraka meda baziranog na botaničkom poreklu. Tečna hromatrografija sa pulsnom amperometrijskom detekcijom (HPLC-PAD) je korišćena za određivanje različitih šećera u medu, dok je diferencijalna skenirajuća kalorimetrija (DSC) korišćena za određivanje faznih prelaza šećera.

Differentiation of the honey samples based on botanical origin using fluorescence spectroscopy, differential scanning calorimetry and HPLC-PAD

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Front-face fluorescence spectroscopy combined with chemometrics is used to differentiate honey samples according to their botanical origin. The emission spectra of two monofloral (linden and acacia) and polyfloral (meadow mix with sunflower) honey types were collected in an excitation range of 300–550nm with the excitation wavelength varying from 270 nm to 380 nm in 5-nm steps. Chemometric analysis of the gathered data included principal component analysis (PCA) and multivariate curve resolution-alternating least squares (MCR-ALS). For the first time the ratio of the protein and phenolic component in the honey emission spectra was used for differentiation of honey samples based on the botanical origins. Liquid chromatography with pulsed amperometric detection (HPLC PAD) was used for determination of the content of different sugars in honey and Differential scanning calorimetry (DSC) was used for measurement of sugar phase transitions.

Prisustvo mikotoksina u brašnu spelte

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Spelta (*Triticum spelta* L.) je jedna od najstarijih vrsta pšenice. Iako se ova drevna pšenica vrednuje kao visokokvalitetna žitarica sa pozitivnim efektima na zdravlje čoveka, njeno dugoročno konzumiranje u velikim količinama može izazvati zdravstvene probleme usled prisustva mikotoksina. U ovom radu prikazani su rezultati istraživanja sadržaja mikotoksina u brašnu od spelte koje je dostupno na srpskom tržištu. Takođe, izvršeno je poređenje sadržaja mikotoksina u speltinom brašnu i rezultata dobijenih za uzorke pšeničnog brašna. Prisustvo aflatoksina (AFLA), ohratoksina A (OTA), deoksinivalenola (DON) i zearalenona (ZEA) ispitano je korišćenjem enzimske imunološke metode (ELISA). Pored toga, određen je sadržaj vlage i ispitano je prisustvo kvasaca i plesni u uzorcima. Studija je potvrdila prisustvo mikotoksina u pojedinim uzorcima speltinog brašna.

Occurrence of mycotoxins in spelt flour

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Spelt (*Triticum spelta* L.) is one of the oldest subspecies of common wheat. This ancient wheat is valued as high quality grain product with pro-health properties, but its long-term consumption in large quantities can cause health problems due to the presence of mycotoxins. This study represents the investigation of the mycotoxins in spelt flour available on the Serbian market, and comparison with other wheat flour products. The presence of aflatoxins (AFLA), ochratoxin A (OTA), deoxynivalenol (DON), and zearalenone (ZEA) was investigated by using the enzyme-linked immunosorbent assay (ELISA). Additionally, moisture content was determined and samples were monitored for yeast and mold. The study confirmed the presence of mycotoxins in some of the investigated spelt flour samples.

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"Gljive u mojoj šolji čaja"

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Čaj ima dugu istoriju korišćenja u tradicionalnoj medicini kao popularni napitak. Zbog toga je od izuzetne važnosti da ispitivanje mikobiote različitih vrsta čajeva. Uzorci biljnih čajeva: *Mentha piperita* (nana), *Thymus vulgaris* (majčina dušica), *Urtica dioica* (kopriva), *Hypericum perforatum* (kantarion), *Camellia sinensis* (zeleni čaj), *Crataegus monogyna* (glog), *Arctostaphylos uva ursi* (uvin čaj), *Sambucus nigra* (zova) i *Achillea millefolium* (hajdučka trava) testirani su na prisustvo mikrogljiva. Usled niskog sadržaja aktivne vode (a_w) u uzorcima za izolaciju mikromiceta korišćene su selektivne hranljive podloge (MY40 i DG18) koje favorizuju rast kserofilnih gljiva. Najviši stepen kontaminacije propagulama gljiva je zabeležen za nanu (859,26 $CFUg^{-1}$) i zovu (737 $CFUg^{-1}$) na DG18 podlozi, dok je umerena kontaminacija zabeležena za zeleni čaj (318,51 $CFUg^{-1}$). U svim uzorcima čaja zabeležene su vrste roda *Aspergillus* dok su vrste rodova *Cladosporium*, *Mucor*, *Penicillium* kao i vrsta *Rhizopus stolonifer* izolovane sa manjom učestalošću. Pravi kserofili, vrste roda *Aspergillus*, sekcije *Aspergilli*, zabeleženi su u svim ispitivanim uzorcima osim u uvinom čaju. Tokom kultivacije, dokumentovano je formiranje kleistotecija sa askosporama, tipičnih za vrste roda *Eurotium*, telomorfni stadijum vrsta sekcije *Aspergilli*. Vrste roda *Aspergillus* su poznati producenti mikotoksina, izazivači alergija i mikoza, stoga njihovo prisustvo u čajevima ne sme biti zanemareno.

Even fungi have their own “cup of tea”

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Tea has a long tradition of use in folk medicine and is a widely popularized as a recreational beverage. In that sense, it is of high importance to examine fungal presence in different teas. A total of nine herbal tea samples: *Mentha piperita* (peppermint), *Thymus vulgaris* (thyme), *Urtica dioica* (common nettle), *Hypericum perforatumI* (St John's wort), *Camellia sinensis* (green tea), *Crataegus monogyna* (hawthorn), *Arctostaphylos uva ursi* (common bearberry), *Sambucus nigra* (black elder) and *Achillea millefolium* (yarrow) were tested for the presence of microfungi. Due to the low water activity (a_w) of examined substrata two selective media for fungal isolation, which favor growth of xerophilic fungi, were used: MY40 and DG18. The highest fungal contamination of tested tea samples were documented on DG18 for *M. piperita* and *S. nigra* samples, 859.26 and 737 $CFUg^{-1}$, respectively, while moderate fungal contamination (318.51 $CFUg^{-1}$) was documented for green tea. The majority of documented fungi belong to genus *Aspergillus*, which were documented in all tested herbal tea samples. *Cladosporium* spp., *Mucor* sp., *Penicillium* spp., and *Rhizopus stolonifer* were less frequent. The highly xerophylic *Aspergillus* species, members of section *Aspergilli*, were documented in all tested samples, exept in common bearberry. During cultivation period an abundance of cleistothecia with ascospores, typical for teleomorphic state of the section *Aspergilli*, *Eurotium* spp. was recorded. *Aspergillus* species are well known mycotoxin producers and causative agents of allergies and mycoses. Hence, their presence in tea must not be neglected.

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Uticaj ekstrakcionog rastvarača na sadržaj polifenola u kakao prahu

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Kakao prah je namirnica sa različitim i dobro dokazanim zdravstvenim efektima, od kojih je većina povezana sa istaknutim antioksidativnim potencijalom kakao polifenola. Do danas, razvoj standardne metode za efikasnu i brzu ekstrakciju polifenola iz hrane ostaje izazov zbog brojnih ograničenja konvencionalnih metoda ekstrakcije. Osnovni eksperimentalni cilj ove studije bio je upoređivanje savremenih „zelenih" rastvarača (holin hlorid-urea i holin hlorid-glicerol) sa konvencionalnim ekstrakcionim rastvaračima (voda, metanol i aceton) u pogledu ekstrakcije polifenolnih jedinjenja iz uzoraka kakao praha. Postupak ekstrakcije vršen je umerenim mešanjem uzorka 24 h na sobnoj temperaturi. Spektrofotometrijski mikroeseji su korišćeni za određivanje ukupnog sadržaja polifenola, flavonoida i proantocijanidina. Dobijeni rezultati ukazuju na to da je korišćeni rastvarač za ekstrakciju značajno uticao na sadržaj ukupnih polifenola ($F(4, 54) = 10{,}124$, $p < 0{,}001$) i flavonoida ($F(4, 54) = 18{,}498$, $p < 0{,}001$). Sadržaj proantocijanina se nije značajno menjao korišćenjem različitih ekstrakcionih rastvarača ($p > 0{,}05$). Najviši sadržaj ukupnih polifenola procenjen je u acetonskim ekstraktima kakao prahova (27,25 mg GAE/g), zatim holin hlorid-urea ekstraktima (25,50 mg GAE/g), metanolnim (18,04 mg GAE/g), vodenim (12,96 mg GAE/g) i holin hlorid-glicerol ekstraktima (12.80 mg GAE/g). Dodatno, LSD *post hoc* testom pokazano je da ne postoji statistički značajna razlika između acetonskih i holin hlorida-urea ekstrakata u smislu ukupnog sadržaja polifenola. Može se zaključiti da eutektička smeša kao što je holin hlorid-urea predstavlja obećavajući pristup eksploataciji fenolnih komponenti kakao praha. Buduća istraživanja treba usmeriti ka integraciji ovog rastvarača u industrijske procese kako bi se proizveli što kvalitetniji dijetetski suplementi bazirani na bioaktivnim kakao jedinjenjima.

Impact of extraction solvent on cocoa powder polyphenol content

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Cocoa powder has various and well-proven health benefits, most of which are associated with prominent antioxidant potential of cocoa polyphenols. To date, development of a standard method for efficient and rapid extraction of polyphenols from foods has remained a challenge due to the inherent limitations of conventional extraction methods. The current study aims to compare modern green extraction (choline chloride-urea and choline chloride-glycerol) with conventional extraction solvents (water, methanol and acetone) applied to samples of cocoa powders in regard to their polyphenol content. This investigation included 11 commercial cocoa powders. Gently shaking at room temperature for 24 hours was considered as extraction procedure. Spectrophotometric microassays were used for determination of total polyphenol, flavonoid and proanthocyanidin content. Obtained results indicated that employed extraction solvent has influenced to total polyphenol ($F(4, 54) = 10.124$, $p < 0.001$) and flavonoid ($F(4, 54) = 18.498$, $p < 0.001$) content. Total proanthocyandin content was similar in all extracts despite different extraction solvents ($p>0.05$). The highest total polyphenol content was evaluated in acetone cocoa powder extracts (27.25 mg GAE/g), followed by choline chloride-urea (25.50 mg GAE/g), methanol (18.04 mg GAE/g), water (12.96 mg GAE/g), and choline chloride-glycerol extract (12.80 mg GAE/g). In addition, LSD post hoc test figured out that there was not statistically difference between acetone and choline chloride-urea extracts in terms of total polyphenol content. It can be concluded that deep eutectic solvent as choline chloride-urea represents promising approach to the exploitation of phenol component from cocoa powder. Future research should be induced to integrate this solvent in industry in order to produce as potent as possible dietary supplements based on cocoa bioactive compounds.

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Хемијски састав два одабрана етарска уља значаја у кулинарству

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У овом раду испитиван је хемијски састав два одабрана узорка етарских уља (жалфија-*Salvia officinalis* и коријандер-*Coriandrum sativum*), у циљу процене њиховог квалитета и безбедне употребе. Квалитативни и квантитивни састав одређен је на гасно-масеном хроматографу, баш као и садржај пестицида и фталата. Тешки метали, међутим, анализирани су методом индуковано спрегнуте плазме са оптичком емисионом спектрометријом (ICP-OES). Одсуство фталата и веома низак садржај тешких метала говоре у прилог квалитету земљишта на коме је дато биље расло. Свеукупно посматрано, оба етарска уља могла би се препоручити за употребу у кулинарству, уколико даље студије потврде њихов квалитет, безбедност и нутритивни потенцијал.

Chemical composition of two selected essential oils of importance for cookery

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This study aimed to determine the chemical composition of two selected samples of essential oils (sage-*Salvia officinalis* and coriander-*Coriandrum sativum*), due to the estimation of their quality and safety. Qualitative and quantitative chemical compositions, along with the contents of pesticides and phtalates, were dermined by GC-MS. However, the presence of heavy metals was examined using ICP-OES. No presence of phtalates coupled with extremely low content of heavy metals have actually indicated high quality of the soil where the plants were grown. Taken all together, both essential oils might be well recommended for the common use in cookery, if additional studies would confirm their quality, safety and nutritional value.

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BKHP78 / FQSP78

Sage essential oil-enriched atmospheres enhance tomato fruit quality

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Tomato fruits (*Solanum lycopersicum* L.) at breaker and red ripening stage were exposed to sage volatile oils (50 ppm or 500 ppm) for 7 days, at 11°C and 95% RH. Quality-related attributes were examined during vapour treatment. Fruit treated with volatiles (500 ppm) increased respiration rate (up to 63% for breaker and up to 42% for red tomatoes) while ethylene production increased in both 50 ppm and 500 ppm volatile concentration, compared to control (un-treated) fruits. Essential oil (50 ppm and 500 ppm) application decreased weight losses up to 46% for breaker ripening stage tomatoes and this effect consists following ripening only for 50 ppm application for the red tomatoes. Indeed, 500 ppm volatiles application for red tomatoes, increased (up to 25%) the weight losses comparing with the control fruit. Tomatoes-enriched with 50 ppm sage oils maintained fruit firmness comparing with higher concentration (500 ppm) in red fruits while no differences observed with controlled fruits. Sage oil-treated red fruit at 50 ppm maintained lycopene content while fruits exposed to 500 ppm revealed a 28% reduction in lycopene content comparing with the control fruits. No differences in lycopene content marked for the breaker fruits. In breaker fruits, increased sage oil concentration marked a steady increase in b-carotene content while no differences observed in red tomatoes. Vapour-treatment did not affect the content of total phenolics and citric acid as well as total soluble solids in both breaker and red tomatoes. Natural volatiles may maintain fruit quality in addition to the well documented antimicrobial protection during fresh produce storage and transit.

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BKHP79 / FQSP79

Antineurodegenerativna aktivnost ekstrakta lista aronije (*Aronia melanocarpa* (Michx.) Elliot) i njegovih frakcija

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Aronija (*Aronia melanocarpa* (Michk.) Elliot) je u poslednje vreme postala jedna od najpopularnijih i najčešće korišćenih vrsta jagodičastog voća. Najčešće se konzumira kao sok, džem, vino, čaj od celog svežeg ili suvog ploda ili otpada nakon proizvodnje sokova, ili kao sastojak funkcionalne hrane, medicinskih ili kozmetičkih proizvoda ili kao dijetetski suplement. Poreklom je iz Severne Amerike, ali se sada gaji širom sveta, posebno u Evropi. Razvijen je veliki broj različitih sorti od kojih su se kao najbolje za gajenje pokazale ‘Nero’, ‘Aron’, ‘Viking’, ‘Rubina’ i ‘Moskva’. Prema literaturnim podacima, postoji značajan broj studija koji se bavi hemijskim sastavom i biološkim aktivnostima aronije, ali samo nekoliko njih se bavi proučavanjem lista aronije. U ovoj studiji ispitivan je hemijski sastav 70% etanolnog ekstrakta lista aronije i njegovih frakcija (petroletarska, etil acetatna, butanolna i vodena) pomoću LC/MS i HPLC/DAD metoda. List aronije organski gajenih biljaka (sorta 'Nero') sakupljen je početkom septembra 2015., nakon što je berba ploda bila završena. Najveći sadržaj ukupnih fenola određen je u butanolnoj frakciji (221,5 mg GAE/g sm). Ova frakcija je takođe bila najbogatija fenolnim kiselinama i flavonoidima (81,1 mg/g sm i 47,6 mg/g sm, redom). Antineurodegenerativna aktivnost uzoraka ispitivana je merenjem sposobnosti inhibicije aktivnosti enzima acetilholinesteraze i tirozinaze u tri koncentracije (100, 200 i 500 mg/mL). Galantamin i kojična kiselina su korišćeni kao pozitivna kontrola. U oba testa najveću aktivnost je pokazao primarni 70% etanolni ekstrakt, dok je od frakcija najefikasniji inhibitor oba enzima bila butanolna frakcija. Inhibitorni efekat uzoraka bio je izraženiji u testu sa tirozinazom (44,56%), gde nije postojala statistički značajna razlika između postignutih efekata ispitivanih koncentracija. Prema našim rezultatima, list aronije bi se mogao smatrati značajnim prirodnim izvorom biološki aktivnih jedinjenja.

Antineurodegenerative activity of chokeberry (*Aronia melanocarpa* (Michx.) Elliot) leaves extract and its fractions

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Chokeberry (*Aronia melanocarpa* (Michx.) Elliot) has recently become one of the most popular and widely used berry fruit usually consumed as a juice, jam, wine, tea made from whole fresh or dry berries or waste after juice production, or as an ingredient of functional food, medicinal products, dietary supplements or cosmetics. It is native to North America but now it has been cultivated throughout the world, especially in Europe. Various cultivars have been developed and the most important for breeding are ‘Nero’, ‘Aron’, ‘Viking’, ‘Rubina’, and ‘Moskva’. Significant numbers of studies are dealing with chemical composition and biological activities of chokeberry but only a few of them are focused on chokeberry leaves. In our study, we investigated the chemical composition of 70% ethanolic extract of chokeberry leaves and its fractions (petroleum ether, ethyl acetate, butanol and water) by LC/MS and HPLC/DAD analysis. Chokeberry leaves were collected at the beginning of September 2015, after berries were harvested from organically grown plants (*Aronia melanocarpa* (Michx.) Elliot, cultivar ‘Nero’). The highest total phenolic content was obtained in butanol fraction (221.5 mg GAE/g dw). This fraction was also most abundant in phenolic acids and flavonoids (81.1 mg/g dw and 47.6 mg/g dw, respectively). Antineurodegenerative activity of chokeberry leaves extract and its fractions was tested using acetylcholinesterase and tyrosinase inhibitory activity assays in three concentrations (100, 200 and 500 μg/mL). Galanthamine and kojic acid were used as a positive control. The most effective inhibitor of both enzymes was 70% ethanolic extract, followed by butanol fraction. The inhibitory effect of the samples was more pronounced toward tyrosinase (44.56%) where statistically significant difference between effects of tested concentrations wasn’t noticed. According to our results, chokeberry leaves could be considered as a valuable natural source of biologically active compounds.

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Biactive properties of Greek garlic genotypes

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Garlic (*Allium sativum* L.) is one of the most economically important species of the Allium genus throughout the world. One of the major beneficial effects of garlic is related with antioxidant properties which have been associated with many therapeutic effects, including cancer prevention, antithrombotic effects, cardiovascular protection and anti-aging effects.

The aim of the present study was to determine the bioactive properties from various Greek garlics in order to determine the variability in their antimicrobial and antioxidant properties, as well as to compare them with commercial cultivars. The collected samples included: one local garlic cultivar from Evros "Nea Vissa" (samples G1 and G2); one sample of a local landrace and one sample of Chinese origin cultivated in Neapoli; (samples G3 and G4, respectively); one sample from Euboea Prefecture of Chinese origin (G5); one sample of local cultivar of "Platykampos", one commercial sample of Chinese origin and one sample of commercial cultivar Gardos, all cultivated in Magnissia Perfecture (G6-G8, respectively), and three samples from Arcadia Prefecture of local cultivar of "Tripoli" (G9-11). The antioxidant activity was evaluated by DPPH radical-scavenging activity, reducing power, inhibition of beta-carotene bleaching and inhibition of lipid peroxidation. The antimicrobial activity was evaluated against four Gram positive bacteria, six Gram negative bacteria and two fungi, using the microdilution method, in order to obtain the minimal growth inhibititory concentrations and minimal bactericidal/funcicidal concentrations.

Genotype G5 showed the lowest EC_{50} values for all the tested antioxidant activity assays. The antimicrobial activity was significant, especially against the bacteria *P. mirabilis* and antibiotic resistant *E. coli*. Significant variation was observed between the studied garlic genotypes, indicating the importance of both growing conditions and genotype on the bioactive properties of dry garlic. This variation could be further exploited in breeding programs in order to select elite genotypes with increased bioactive properties.

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BKHP81 / FQSP81

Stability of ascorbic acid, tocopherols and total folates in irradiated buckler sorrel leaves during refrigerated storage

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Ready-to-eat vegetables have become more popular in consumers' market baskets due to their convenience and health benefits. The growth of this sector has promoted the introduction of new foods and the adoption of more efficient and eco-friendly postharvest technologies such as irradiation. However, a common consumer concern is whether irradiation adversely affects the nutritional value of food. In this sense, the suitability of post-packaging irradiation for preserving buckler sorrel (*Rumex induratus* Boiss. & Reut.) vitamins during refrigerated storage was evaluated. Buckler sorrel samples gathered in the Northeastern region of Portugal were hand-picked and a portion was immediately analyzed (fresh control). The remaining fresh material was packaged in polyethylene bags, irradiated at doses up to 6 kGy in a ^{60}Co experimental chamber, and stored at 4 ºC for 12 d. A non-irradiated control followed the experiment. Ascorbic acid, tocopherols and total folates were analyzed by HPLC techniques. The four tocopherol isoforms were identified; α-tocopherol was the most abundant one in the fresh control, followed by γ-tocopherol. The treatment caused a decrease in the α-tocopherol levels, which was more marked with the consequent increase in dose. Interestingly, the non-irradiated stored control had the highest total tocopherol content (promoted especially by the γ isoform). In turn, ascorbic acid was more sensitive to irradiation than to storage time, while folates were only affected by the 2 kGy dose. Therefore, packaging and refrigeration were enough for the preservation of buckler sorrel vitamins for 12 d.

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BKHP82 / FQSP82

Tečno-hromatografsko određivanje odabranih organskih kiselina u voću i sokovima

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Metoda izokratske reverzno-fazne tečne hromatografije pod visokim pritiskom (HPLC) sa UV-Vis detekcijom je prilagođena i primenjena za određivanje askorbinske, oksalne, mlečne i limunske kiseline u uzorcima odabranog voća i voćnih sokova. Ova metoda je primenjena u cilju utvrđivanja promena u koncentracijama ispitivanih organskih kiselina u toku različitih faza proizvodnje voćnih sokova u laboratorijskim uslovima. Askorbinska kiselina, poznata i kao vitamin C, je važan prirodni antioksidans, koji je prisutan u različitim namirnicama i napitcima. Ostale ispitivane organske kiseline utiču na ukus, boju, stabilnost i kvalitet voćnih sokova. Određivanje sadržaja organskih kiselina i ukupne kiselosti su značajni za praćenje procesa prerade voća i proizvodnje voćnih sokova. Predložena metoda je uspešno primenjena za analizu realnih uzoraka, i validacijom je potvrđena kao osetljiva, ponovljiva i tačna.

Detremination of Selected Organic Acids in Fruits and Juices by Liquid Chromatography

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The isocratic reversed phase high pressure liquid chromatographic (HPLC) method with UV-Vis detection for the determination of ascorbic, oxalic, malic and citric acids was evaluated and applied for selected fruits and juices. The method was applied in order to investigate the changes in organic acids concentration during different phases of juice production under laboratory conditions. Ascorbic acid, commonly known as vitamin C, is an important natural antioxidant, present in a wide range of food and beverages. The rest of the investigated organic acids could influence taste, color, stability and quality of produced juices. Determination of organic acids content and acidity control are relevant for fruit processing and juice production. A proposed method was successfully used for the analyzes of samples, and was confirmed as sensitive, with good reproducibility and accuracy through validation process.

BKHP83 / FQSP83

Dahlia mignon as a source of soluble sugars and glycosilated flavonoids with bioactive properties

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The recent preoccupation with healthier living conditions has increased consumer interest in products that have beneficial effects. Edible flowers have been reported since ancient times in Asia, ancient Greece and Rome, medieval France, England and in the Middle East region as a healthy alternative. The aim of this study was to determine the individual profile of soluble sugars and glycosylated flavonoids in dahlia petals and in its infusion, and also to evaluate the bioactive properties. The soluble sugars were determined by high performance liquid chromatography coupled to a refractive index detector (HPLC-RI), while the phenolic profile was determined by HPLC-DAD-ESI/MSn. Furthermore, the bioactive properties were evaluated through the antioxidant, antibacterial and antiproliferative activities. Fructose, glucose and sucrose were found in the petals and infusions, being fructose the main sugar present in petals (10.24 ± 0.62 g/100 g dw), and in the infusion (0.19 ± 0.02 mg/100 mL). The phenolic profile of dahlia sample presented a total of 21 compounds, being the main molecule naringenin-3-*O*-glucoside. Dahlia petals presented a higher antioxidant activity than the infusion for DPPH scavenging activity (0.63 ± 0.01 and 1.17 ± 0.05 mg/mL, respectively) and β-carotene bleaching inhibition (0.48 ± 0.02 and 2.01 ± 0.07 mg/mL, respectively), while for the reducing power the infusion revealed a higher potential (1.33 ± 0.07 and 0.799 ± 0.001 mg/mL, respectively). Dahlia petals and infusion gave the lowest GI_{50} values against HeLa (223.65 ± 2.78 μg/mL) and MCF-7 (361.99 ± 28.83 μg/mL, 303.27 ± 26.13 μg/mL respectively) cell lines. The samples were active against most of the tested microorganisms, however, the samples were found to be more active against Gram-positive bacteria with MICs ranging from 2.5 to 5 mg/mL. These results confirm the potential of *Dahlia mignon* as a source of bioactive compounds with interest for the pharmaceutical and food industries.

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BKHP84 / FQSP84

FENOLNI „OTISAK PRSTA“ MEDA OBIČNE PLANIKE (*Arbutus unedo* L.)

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Med obične planike (*Arbutus unedo* L.) jeste redak monoflorni med gorkog ukusa, poreklom sa mediteranskog područja (Korzika, Hrvatska, Portugalija, Sardinija i Španija). Poseduje lekovita svojstva zbog snažne antioksidativne aktivnosti i visokog masenog udela fenolnih jedinjenja. Cilj ovog rada bio je da se utvrdi polifenolni profil („otisak prsta“), ukupni fenolni sastav i kapacitet hvatanja radikala meda obične planike poreklom sa poluostrva Pelješca u Hrvatskoj. Polifenolni profil je određen primenom ultra-efikasnog tečnog hromatografa (UHPLC) sa hibridnim masenim analizatorom (LTQ Orbitrap MS). Identifikovano je 55 polifenola (fenolnih kiselina i flavonoida) na osnovu karakterističnih masenih spektara i fragmenata. Med obične planike imao je veći sadržaj ukupnih fenola (1038 mg ekvivalenata galne kiseline po kilogramu meda) i jači kapacitet hvatanja DPPH (2,2’-difenil-1-pikrilhidrazil) radikala (3,32 mmol ekvivalenata Trolox-a po kg meda) u poređenju sa drugim vrstama monoflornih medova. Zaključeno je da med obične planike ima veliki potencijal kao hrana koja povoljno deluje na ljudsko zdravlje.

PHENOLIC “FINGERPRINT” OF STRAWBERRY TREE (*Arbutus unedo* L.) HONEY

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Strawberry tree (*Arbutus unedo* L.) honey is a rare monfloral bitter honey that originates from the Mediterranean area (Corsica, Croatia, Portugal, Sardinia, and Spain) and possesses many beneficial health effects due to its strong antioxidant activity and high phenolic content. The aim of this study was to determine the polyphenolic profile (“fingerprint”), the total phenolic content and radical scavenging capacity of strawberry tree honey from the Pelješac peninsula, Croatia. Polyphenolic profiling was performed by ultra-high performance liquid chromatograph (UHPLC) coupled to hybrid mass spectrometer (LTQ Orbitrap MS). Fifty-five polyphenolics (phenolic acids and flavonoids) were identified according to their characteristic mass spectra and fragmentation pattern. Strawberry tree honey showed higher phenolic content (1038 mg gallic acid equivalents per kg of honey) and stronger DPPH (2,2′-diphenyl-1-picrylhydrazyl) scavenging activity (3.32 mmol Trolox equivalents per kg of honey) compared to the monofloral honeys of other botanical origins. Our results indicate that strawberry tree honey has great potential as a health promoting food due to the presence of large quantities of polyphenolic compounds

OHP1 / FCHP1

Uticaj načina gajenja (konvencionalni, organski i integrisani) na polifenolni sadržaj četiri sorte paprika (*Capsicum annuum* L.)

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Paprika je značajna poljoprivredna kultura sa visokim sadržajem biološki aktivnih komponenti koje povoljno utiču na zdravlje ljudi. Razlike između konvencionalne, organske i integrisane proizvodnje mogu da utiču na hranljive vrednosti biljaka. Sveža paprika je vrlo hranljiva namirnica sa visokim sadržajem vitamina C i E, provitaminom A, karotenoidima, fenolnim kiselinama i flavonoidima, koji najviše doprinose antioksidativnoj aktivnosti. Ishrana bogata antioksidansima može da spreči kardiovaskularne i neurodegenerativne bolesti i dijabetes. Cilj ovog rada bio je da se uporedi polifenolni sadržaj plodova i semena četiri sorte slatke paprike gajene u konvencionalnim, organskim i integrisanim poljoprivrednim sistemima, tokom dve uzastopne godine. Ispitivane su tri strane sorte paprika (”Enea”, ”Atris”, i ”Capture”) i i jedna sorta iz Srbije (”Mišina”). Petnaest polifenola je identifikovano i kvantifikovano u semenu i perikarpu ispitivanih paprika.

Influence of cultivation method (conventional, organic and integrated) on polyphenolic content of four sweet pepper (*Capsicum annuum* L.) cultivars

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Pepper is an important agricultural crop with significant level of biologically active components which are beneficial for human health. Difference between conventional, organic and integrated cultivation may affect the nutritive value of plants. Fresh pepper fruits are very valuable nutrients with high content of vitamins C and E, provitamin A, carotenoids, phenolic acids and flavonoids, which are the major contributors of their antioxidant activity. A diet rich in antioxidants may prevent various diseases, such as cardiovascular and neuro-degenerative diseases, chronic diseases and diabetes. The aim of this work was to compare polyphenolic content in fruits and seeds of four sweet pepper cultivars grown under conventional, organic and integrated agricultural systems during two years. Three cultivars investigated in this work were imported (cvs ”Enea”, ”Atris”, ”Capture”) and was Serbian cultivar ”Mišina”. Fifteen polyphenolics were indentified and quantified in investigated pepper seeds and fruits.

OHP2 / FCHP2

Očuvanje bioaktivnih jedinjenja aronije metodom sprej sušenja, karakterizacija mikročestica i *in vitro* metoda digestije

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U poslednjoj deceniji, aronija je u fokusu interesovanja zbog mnogobrojnih pozitivnih efekata na ljudsko zdravlje. Plod aronije je jedan od najznačajnijih izvora polifenola (antocijana, flavanola, procijanidina, fenolnih kiselina). Problem sa nestabilnošću polifenola može se rešiti pomoću mikrokapsulacione tehnike-sprej sušenja, jednostavne i ekonomične metode za kontrolisanu proizvodnju uniformnih čestica, pogodnih za upotrebu u industriji hrane. Ekstrakt aronije-CE i ekstrakt ostatka nakon ceđenja-CWE su mikroinkapsulirani nosačima maltodekstrin-MD i obrano mleko-SM. Ciljevi ove studije bili su: poboljšanje funkcionalnost i stabilnost ekstrahovanih polifenola aronije metodom mikroinkapsulacije, karakterizacija dobijenih mikrosistema (FTIR, SEM, veličina čestica, zeta potencijal-ZP, sadržaj vlage, efikasnost inkapsulacije-EE%) i ispitivanje bioraspoloživosti mikroinkapsulisanih polifenola korišćenjem *in vitro* simulirane metode digestije. Dobijeni rezultati su pokazali da je sušenje raspršivanjem pogodna tehnika za mikroinkapsulaciju ekstrakata. Dobijene su mikročestice veličine 4,72-11,0 µm, sadržaja vlage 3,39-4,61%. SEM analiza je pokazala da su sa MD dobijene uniformne mikročestice glatkih površinskih struktura, a FTIR spektar nekoliko relevantnih pikova, ukazujući da su ekstrakti uspešno inkorporirani u matriks biopolimera. Rezultati ZP ukazuju na stabilne mikročestice, bez agregacija. Sve dobijene mikročestice pokazale su visoku EE% (63,5-97,3%). Za oba ispitivana ekstrakta, bolje oslobađanje polifenola postignuto je upotrebom MD (2,56 mg GAE/g za CE, 24,26 mg GAE/g za CWE) u poređenju sa inkapsuliranim SM (2,07 mg GAE/g za CE, 18,45 mg GAE/g za CWE). MD i SM su pokazali značajan uticaj na smanjenje degradacije polifenola tokom procesa digestije, pri čemu je MD pokazao najveći potencijal, posebno kod inkapsuliranog CWE. Mikroinkapsulirani ekstrakti aronije, predstavljaju obećavajući dodatak u proizvodnji dijetetskih suplemenata ili funkcionalne hrane.

Ključne reči: aronija, mikrokapsulacija, polifenoli/anthocianini, digestija

Chokeberry bioactives preservation by spray drying method, microparticles characterisation and *in vitro* digestion method

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In the last decade, chokeberry has attracted much attention due to many beneficial effects on human health. It is an excellent source of polyphenols (anthocyanins, flavonols, procyanidins, phenolic acids). Problem with polyphenols instability can be solved by microencapsulation technique, spray drying, simple, low cost method for controlled production of uniform particles, appropriate for food industry use. Encapsulation of chokeberry extract-CE and chokeberry waste extract-CWE using carriers (maltodextrin-MD, skimmed milk-SM) was examined. The aim of the study was: improving functionality and stability of extracted chokeberry polyphenols by microencapsulation, characterisation of obtained microsystems (FTIR, SEM, particle size, zeta potential-ZP, moisture content, encapsulation efficiency-EE%), as well to investigate bioavailability of microencapsulated phenolics using *in vitro* simulated digestion method. Result showed that spray drying was a convenient technique for extracts microencapsulation. Obtained microparticles sizes ranged from 4.72-11.0 µm, with moisture content 3.39-4.61%. SEM analysis showed that MD usage gave well formed particles with uniform sizes, FTIR showed several relevant picks, indicating that extracts were successfully incorporated into biopolymer matrix. ZP results pointed to stabile microbeads, without particles aggregation. All obtained microparticles exhibited high EE% (63.5-97.3%). For both examined extracts, better polyphenols release was achieved with MD (2.56 mg GAE/g for CE, 24.26 mg GAE/g for CWE) comparing with encapsulated SM (2.07 mg GAE/g for CE, 18.45 mg GAE/g for CWE). MD and SM showed significant effect on polyphenols degradation during digestion process, having the MD the highest protective effect, especially when waste extract was encapsulated. Chokeberry microbeads, due to their antioxidant potential, represent a promising food additive for incorporation into dietary suplements or functional food.

Keywords: chokeberry, microencapsulation, polyphenols/anthocyanins, digestion

OHP3 / FCHP3

Optimizacija postupka ekstrakcije polifenolnih jedinjenja iz semenki grožđa

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Grožđe (*Vitis vinifera* ssp. *sativa*) predstavlja bogat izvor fenolnih jedinjenja, od kojih su najznačajnija antocijani, proantocijanidini i fenolne kiseline. Ovo voće se najčešće koristi u vinskoj industriji. Semenke grožđa, jedan od nusproizvoda u postupku proizvodnje vina, su posebno bogate fenolnim jedinjenjima koja su od velikog interesa zahvaljujući njihovim zdravstvenim efektima. Cilj našeg rada bio je optimizovati proces ekstrakcije fenolnih jedinjenja iz semenki grožđa i tako dobiti ekstrakt sa najvećim sadržajem polifenola. Ispitivanje je izvršeno na obezmašćenim semenkama bele sorte grožđa. Sa ciljem da uporedimo njihovu efikasnost, ispitivali smo uticaj različitih ekstrakcionih tehnika, kao što su: magnetna mešalica, ultrazvučno kupatilo i šejker. Takođe smo razmatrali i uticaj upotrebljenog ekstrakcionog rastvarača: aceton, metanol i destilovana voda. Ukupan sadržaj polifenola određen spektrofotometrijskom metodom korišćen je za evaluaciju najefikasnije ekstrakcione procedure. Najviši sadržaj ukupnih polifenola je određen u acetonskom ekstraktu dobijenom korišćenjem magnetne mešalice (80,47 mg GAE/g), a zatim i ekstrakcijom na ultrazvučnom kupatilu pomoću istog rastvarača (79,49 mg GAE/g). Najniži polifenolni sadržaj je određen u vodenim uzorcima ekstrahovanim na ultrazvučnom kupatilu (20,79 mg GAE/g). Svi vodeni ekstrakti su imali značajno niži sadržaj polifenolnih jedinjenja u odnosu na one ekstrahovane metanolom i etanolom ($p<0,05$). Na osnovu dobijenih rezultata, optimalni uslovi za ekstrakciju polifenolnih jedinjenja iz semenki grožđa su ostvareni izborom magnetne mešalice kao ekstrakcione tehnike i acetona kao rastvarača. Ova studija može predstavljati dobru osnovu za dalja ispitivanja koja bi za cilj imala pronalazak još boljeg i efikasnijeg postupka ekstrakcije fenolnih jedinjenja iz semenki grožđa. Takođe, ekstrakt semenki grožđa je jeftin izvor prirodnih antioksidanasa i može se potencijalno koristiti kao sastojak funkcionalnih namirnica.

Extraction optimization of polyphenols from grape seeds

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Grape (*Vitis vinifera* ssp. *sativa*) is a rich source of phenolic compounds, among which the most important are anthocyanins, proanthocyanidins and phenolic acids. This fruit is mainly used in wine industry. Grape seed, by product of winemaking process, is especially rich in phenolic compounds that are of great interest due to their health benefits. The aim of our study was to optimize the extraction process of phenolic compounds from grape seeds and to obtain the extract with the highest amount of polyphenols. Extraction optimization was conducted on white grape variety and defeated samples of grape seeds were used. We investigated the influence of different extraction techniques, such as magnetic stirrer, ultrasonic bath and shaker in order to compare their efficiency. Also, we took into account the effect of three solvents: acetone, methanol and distilled water. Total polyphenol content (TPC) determined by spectrophotometric method was used for evaluation of the most efficient extraction procedure. The highest content was found in acetone extract obtained using magnetic stirrer (80.47 mg GAE/g), followed by samples extracted with the same solvent, but after ultrasonic heating (79.49 mg GAE/g). The lowest amount of phenolics was determined in water samples extracted by ultrasonic bath (20.79 mg GAE/g). All water extracts had significantly lower TPC values in comparison with those extracted using methanol and acetone ($p<0.05$). According to obtained results, optimal conditions for extraction of total polyphenols from grape seeds were provided using acetone as a solvent on magnetic stirrer. This study could be a good base for conducting further investigations in order to achieve even better and more efficient extraction process of phenol compounds from grape material. Also, grape seed extract is an inexpensive source of natural antioxidants and could be potentially used as a functional food ingredient.

Fenolni profil duga trešnjinog drveta

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Prilikom starenja alkoholnih pića u prisustvu drveta dolazi do važnih promena u aromi, boji, ukusu i gorčini, usled interakcije između jedinjenja iz drveta i destilata. Iako se hrast najviše koristi za čuvanje alkoholnih pića, i druge vrste, kao što su kesten, trešnja, bagrem i dud, se mogu koristiti. Cilj rada bio je da se okarakteriše ekstrakt duga trešnjinog drveta primenom HPLC-MS i spektrofluorometrijske metode. Dobijeni rezultati ukazali su na to da je stablo trešnje bogato fenolnim jedinjenjima. Spektrofluorometrijski rezultati ukazuju na razliku trešnjinog drveta i njegovog ekstrakta u odnosu na druge vrste drveta, zbog prisustva specifičnih flavonoida u ovom drvetu. Najzastupljenije ispitivano jedinjenje je taksifolin, a pored njega pronađene su značajne količine pinocembrina, naringenina, hrizina, apigenina, kvercetina, kempferola, elaginske kiseline, genisteina, čije su koncentracije bile veće od 10 mg/L.

Phenolic profile of seasoned cherry heartwood staves

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During aging in the presence of wood, beverages undergo a series of processes leading to important changes in aroma, color, taste and astringency because of the interaction between compounds present in the wood and beverages. Although oak heartwood is the most used material in cooperage, other species such as chestnut, cherry, acacia and mulberry can also be considered. The objective of this research was the characterization of seasoned cherry staves by HPLC-MS method and spectrofluorometry. The results showed that cherry wood originating from Serbia was rich in phenolic compounds. Spectrofluorometric results indicate the difference between cherry wood and its extract comparing with other wood species due to the presence of specific flavonoids in this wood. The most abundant investigated compound was taxifolin. Also, significant amounts of pinocembrin, naringenin, chrysin, apigenin, quercetin, kaempferol, ellagic acid, genistein were also found, in concentration higher than 10 mg/L.

Njeguški pršut, prvi geografski zaštićen proizvod u Crnoj Gori

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Stanovnici grada Cetinja i šire okoline nasledili su od svojih predaka tehnološki postupak pripreme, soljenja i sušenja pršuta. Svoj visoki kvalitet zadržali su do danas kada su karakteristike pršuta, posebnost i kvalitet prepoznati kroz zaštićenu oznaku izvornosti.
Po predanju, proizvodnju Njeguškog pršuta, stanovnici Njeguša naslijedili su u XV vijeku od stanovništva kojega su zatekli na tim prostorima.
Njeguški pršut prvi je crnogorski proizvod koji je nacionalnim zakonodavstvom zaštićen kao geografska oznaka kvaliteta.
Proizvod koji će nositi zaštićen naziv "Njeguški pršut" definisan je kao trajni suhomesnati proizvod od svinjskog buta bez nogice, sa kosti, kožom i potkožnim masnim tkivom, bez karličnih kostiju, suvo soljen morskom solju, dimljen sporim sagorijevanjem suvog bukovog drveta u posebnim tehnološkim uslovima i podvrgnut procesu sušenja i zrenja u trajanju od najmanje godinu dana.
Moderne tehnologije, međutim ne mijenjaju nekoliko vjekova star način sušenja na bukvi i promaji. Ali, prema proizvođačkoj specifikaciji, kao zaštićeni proizvod "Njeguški pršut", usklađena sa standardima EU, mora da sadrži procenat soli, 4 – 5 % u odnosu na tradicionalni, gde je procenat soli iznosio čak 8 – 9 %. U ovom slučaju process sazrevanja i sušenja pršuta, koji je trajao najmanje devet mjeseci, sada, mora da traje duže, najmanje godinu dana.
Kvalitet proizvoda "Neguški pršut" postiže se mikroklimatskim karakteristikama ovog kraja gdje se mješaju mediteranska i planinska klima, na području neposredno iznad mora, na nadmorskoj visini od oko 800 m, uz recepte stare preko stotinu godina, kao i poseban ukus i miris koji pršuti daje bukovo drvo sa Lovćena, koje se koristi za sušenje pršute.

Njegus prosciutto, the first geographical-protected product in Montenegro

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Residents of the city of Cetinje and its wider area inherited from their ancestors a technological process for preparing, salting and drying pork ham (prosciutto). They have maintained their high quality until these days; therefore the characteristics of prosciutto, specialty and its quality are recognized through the protected designation of origin.
As a tradition, the production of Njegus prosciutto, inhabitants of Njegus inherited in the XV century from the population they found in those areas.
Njegus prosciutto is the first Montenegrin product that is protected by national legislation as a geographical indication of quality.
The product that will carry the protected name "Njegus prosciutto" is defined as a permanent dried meat product from a pig without foot, with bone, skin and subcutaneous fat, without pelvic bones, dried salted with sea salt, smoked by slow combustion of dry beech wood in special technological conditions and subjected to a drying and ripening process of at least one year.
Modern technologies, however, do not change the centuries-old method of drying on the beech and breeze airflow. However, according to the manufacturer's specification, and since it is a protected product "Njegus prosciutto", harmonized with the EU standards, it has to contain a salt percentage of 4-5% compared to traditional, where the salt percentage was as much as 8 - 9%. In this case, the process of meringue and drying of the ham, which lasted at least nine months, now, has to last a year at least.
The quality of the product "Negus prosciutto" is achieved by the microclimate characteristics of this region where the Mediterranean and mountain climates are mixed - in the area just above the sea, at an altitude of about 800 m, with recopes over a hundred years old, as well as the special taste and smell that smoked beech wood from Lovćen, used for drying of ham.

OHP6 / FCHP6

Elektroanalitičke procedure za kvantifikaciju pesticida u komercijalnim formulacijama

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Nove elektroanalitičke procedure razvijene su u cilju određivanja sadržaja pojedinih pesticida u komercijalnim formulacijama pesticida primenom hronopotenciometrije. Kao radne elektrode korišćene su elektroda od staklastog ugljenika i tankoslojna živina elektroda za određiavnje insekticida imidakloprida i herbicida metamitrona i metribuzina. Kod svih određivanih pesticida dobijen je jedan redukcioni pik kao rezultat ireverzibilne redukcije analita na radnoj elektrodi. Kvantifikacija pesticida u komercijalnim formulacijama je izvedena nakon optimizacije i validacije hronopotenciometrijske metode. Uzorci komercijalnih formulacija pesticida prvobitno su rastvoreni u bidestilovanoj vodi, acetonitrilu ili etanolu, za imidakloprid, metamitron i metribuzin, po redosledu navođenja. Ultrazvučni tretman u trajanju od 2 min je primenjen da bi se olakšalo rastvaranje. Krajnje razblaženje izvedeno je u Britton-Robinson puferu optimalne pH vrednosti. Kvantitativno određivanje pesticida izvedeno je primenom metode kalibracione krive, a svaki uzorak je analiziran u tri ponavljanja. Dobijene srednje vrednosti prinosa i RSD za 13 uzoraka komercijalnih formulacija iznosile su 100,22% i 0,01%, što ukazuje na tačnost i preciznost razvijenih hronopotenciometrijskih metoda.

Electroanalytical procedures for quantification of pesticides in commercial formulations

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Novel electroanalytical procedures are developed for determination of different pesticides content in commercial pesticide formulations using chronopotentiometry. As a working electrode glassy carbon electrode and thin film mercury electrode are used for determination of insecticide imidacloprid and herbicides metamitron and metribuzin. For all determined pesticides one reduction peak is obtained, as a result of irreversible reduction of the analyte on the working electrode. Quantification of pesticides in commercial formulations is performed after optimization and validation of the chronopotentiometric method. Samples of commercial pesticide formulations are primarily dissolved in doubly distilled water, acetonitrile and ethanol for imidacloprid, metamitron and metribuzin, respectively. Ultrasound treatment in duration of 2 min is used to support dissolution. The final dilution is performed in the Britton-Robinson buffer of optimal pH value. Quantitative determination of the pesticide is performed using the calibration curve method, while every sample is analyzed in triplicate. Obtained average recovery and RSD value for 13 samples of commercial pesticide formulations is 100.22% and 0.01%, indicating on the accuracy and precision of the chronopotentiometric method.

OHP7 / FCHP7

Toplotni tretmani fermentisanih suvih kobasica u redukciji rizika od najvažnijih bakterijskih alimentarnih patogena

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Bezbednost fermentisanih suvih kobasica može biti kompromitovana u slučaju kontaminacije sirovina većim brojem patogena i/ili ukoliko antimikrobne mere tokom postupka proizvodnje nisu sprovedene na odgovarajući način. Jedan od pristupa za dodatno unapređenje bezbednosti date kategorije proizvoda je blaga toplotna obrada s obzirom na uspešnost dejstva i jednostavnost primene. Može se sprovesti različitim temperaturno/vremenskim kombinacijama pri čemu su ispitane temperature u rasponu od 43 °C do 90 °C. U slučaju *Salmonella* spp., studije su pokazale da je moguće postići redukciju od 3,6 do 6,5 log CFU/g, zavisno od koraka proizvodnje kobasica u kom se toplotni tretman primenjuje (tj. pre fermentacije, posle fermentacije ili posle zrenja). Druga istraživanja ukazuju da su patogene *Escherichia coli* (prvenstveno serotip O157) do izvesne mere otpornije u odnosu na *Salmonella* spp., zbog čega je potrebno primeniti nešto više temperature ili dužu izloženost toplotnom tretmanu radi postizanja značajnijeg nivoa redukcije (>2 log CFU/g). Studije o redukciji *Listeria monocytogenes* toplotnim tretmanima su dale različite rezultate koji se kreću od potpunog izostanka dejstva do smanjenja navedenog patogena za 3 log CFU/g. Generalno, niže temperature toplotnih tretmana koje se primenjuju tokom dužeg vremena i to na kraju proizvodnog postupka, dovode do zadovoljavajućeg smanjenja nivoa glavnih bakterijskih alimentarnih patogena; istovremeno, negativni uticaji na senzorne odlike gotovih proizvoda su slabije izraženi ili čak izostaju.

Heat treatments of dry fermented sausages in risk reduction of the main bacterial foodborne pathogens

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Safety of dry fermented sausages (DFS) can be compromised by the initial contamination of the raw materials with higher levels of pathogenic bacteria and/or insufficient control of the antimicrobial factors during the production process. Besides other additional strategies for enhancing safety, application of mild heat treatments present one of the most effective and easy-to-use risk reduction measure. It include application of various time temperature regimes with temperature ranging from 43 °C up to 90 °C. In case of *Salmonella* spp., the studies demonstrated that is possible to achieve reduction of 3.6 to 6.5 log CFU/g, depending on the step of sausages' production in which the heat treatment is applied (i.e. before fermentation, after fermentation, or after ripening). Other investigations found that pathogenic *Escherichia coli*, mainly serotype O157, are somewhat more tolerant to heat treatments compared to *Salmonella*, so that slightly higher temperature or prolonged exposure are needed to achieve appreciable level of reduction (>2 log CFU/g). Studies on *Listeria monocytogenes* reduction by heat treatments showed different results, ranging from total absence of effects to 3 log CFU/g decrease. In general, lower temperature treatments applied for longer time and at the end of processing of sausages achieved satisfactory reduction of main bacterial foodborne pathogens; at the same time, negative effects on sensorial characteristics of finished products were less pronounced or even absent.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP8 / FCHP8

Mikrobiološki status mariniranih pilećih filea upakovanih u vakuum

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U ovom istraživanju ispitivao se uticaj korišćenja marinade na mikrobiološki status pilećih filea upakovanih u vakuum i skladištenih na temperaturi do 4 °C. Ukupno 120 pilećih filea bez kože (korišćenih za dva ponavljanja) marinirano je u kontrolnom rastvoru i tri različite vrste eksperimentalnih rastvora marinada: 6% NaCl (kontrola), 6% NaCl i 2% natrijum tripolifosfat (STPP) (T1), 6% NaCl i 2% citrat (T2) i rastvor sa 6% NaCl, 1% STPP i 1% citrata (T3). Odnos filea i marinade bio je 1:2. Nakon pet sati mariniranja filei su upakovani u vakuum. Svakog dana uzorkovanja (0, 7, 14, 21 i 28 dan skladištenja) po tri uzorka iz kontrolne i ogledних grupa su nasumično odabrani za utvrđivanje broja *Enterobacteriaceae*, ukupnog broja mezofilnih bakterija (UBB), bakterija mlečne kiseline (BMK) i anaerobnih bakterija. U uzorcima filea mariniranih u rastvoru sa 1% i 2% citrata utvrđen je značajno niži broj *Enterobacteriaceae* (2,70 log CFU/g, 2,64 log CFU/g, $P < 0,05$, pojedinačno), u odnosu na druge dve grupe, dok je dodavanje 2% citrata u marinadu dovelo do pada broja *Enterobacteriaceae* za 1,85 log CFU/g do 28 dana. Ukupan broj mezofilnih bakterija i broj BMK rastao je u svim grupama osim u T2 grupi. Najviši UBB bio je u kontrolnoj i grupi sa 2% STPP (7,03 log CFU/g, 6,94 log CFU/g, $P > 0,05$, pojedinačno). Dodavanje 2% citrata u marinadu inhibiralo je rast BMK i njihov broj se kretao u opsegu od 2,33 do 2,90 log CFU/g tokom skladištenja. Utvrđen je najznačajniji porast u broju anaerobnih bakterija tokom vremena i on je bio viši od 7 log CFU/g na kraju perioda skladištenja sa izuzetkom u T2 grupi (3,97 log CFU/g, 28. dan). Na osnovu dobijenih podataka mikrobioloških analiza može se zaključiti da vakuum pakovanje u kombinaciji sa 2% citrata u rastvoru marinade može biti efikasan način za produžavanje održivosti pilećeg filea.

Microbiological quality of marinated vacuum-packaged chicken breast fillets

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This study evaluated the effect of dipping in a marinade solution on the microbiological quality of chicken fillets packaged under vacuum and stored at 4 °C. A total of 120 skinless breast fillets (used for the 2 trials) were marinated in control and three different treatment solutions: 6% NaCl (control), 6% NaCl and 2% sodium tripolyphosphate (STP) (T1), 6% NaCl and 2% sodium citrate (T2), and solution with 6% NaCl, 1% STP and 1% sodium citrate (T3). The fillets-to-marinating-solution ratio was 1:2. After five hours of marination, breasts fillets were vacuum-packaged. At each sampling period (day 0, 7, 14, 21 and 28 of storage) 3 treatments and 3 control breast fillets were randomly selected for *Enterobacteriaceae*, Total viable count (TVC), Lactic acid bacteria (LAB) and anaerobic bacteria enumeration. In samples of the fillets marinated in a solution with 1% and 2% sodium citrate, a significantly lower number of *Enterobacteriaceae* (2.70 log CFU/g, 2.64 log CFU/g, $P < 0.05$, respectively) was found compared to the other two treatments, while the addition of 2% sodium citrate led to *Enterobacteriaceae* count decrease by 1.85 log CFU/g by the day 28. TVC and LAB count increased during storage in all treatments except in T2 treatment. The highest TVC was in control and in treatment with 2% STP (7.03 log CFU/g, 6.94 log CFU/g, $P > 0.05$, respectively). The addition of 2% sodium citrate inhibited LAB growth ranging from 2.33 to 2.90 log CFU/g during storage. The most significant increase was in anaerobic bacterial count over time, wherein their numbers were higher than 7 log CFU/g at the end of the storage, with the exception in the T2 treatment (3.97 log CFU/g on day 28). Based on the microbiological data obtained, the use of vacuum-packaging in combination with 2% sodium citrate marinade solution may be an effective means of extending the shelf life of the chicken breast fillets.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP9 / FCHP9

Senzorna analiza prirodnih i veštačkih sistema u studiji ljudske percepcije ulja

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Senzorna analiza urađena u okviru ove studije podrazumevala je učešće 30 participanata (po 15 muškaraca i žena) testiranih na 6 modela hrane: 1. ulje od uljane repice, 2. svinjska mast, 3. oleinska kiselina (18:1), 4. silikonsko ulje, 5. glicerol i 6. ksantan guma. Participanti su odgovarali sa "da" ili "ne" na pitanje: Da li je ovo ulje? Dobijeni podaci pokazali su da tekstura ulja, kao i molekuli arome, igraju veliku ulogu u ljudskoj percepciji ulja. Bez daljnjeg, isto je od posebne važnosti za dizajniranje hrane sa malim procentom ulja u vremenu pred nama.

Sensory analysis of natural and artificial model systems in human fat perception study

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Sensory analysis performed within this study included 30 participants (15 men and women each) tested on 6 food systems: 1. Rapeseed oil, 2. Animal fat (lard), 3. Oleic acid (18:1), 4. Silicone oil, 5. Glycerol, and 6. Xanthan gum. The participants had to respond either with "yes" or "no" to the following question: Is this fat? The obtained data have indicated that fat texture, along with aroma molecules, plays a big role in human fat perception. Without a doubt, these findings are of great importance for design of low-fat foods in the time to come.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP10 / FCHP10

Određivanje sadržaja slobodnih polifenola i flavonoida u organski i konvencionalno proizvedenom semenu soje (*Glycine max* L.)

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Soja, mahunarka iz familije *Fabaceae*, poseduje visok nivo antioksidanata, koji imaju antitumorsko i hemopreventivno dejstvo. Cilj ovog rada bila je detekcija sadržaja najvažnijih antioksidanata - polifenola i flavonoida u semenu soje dobijenog iz dva različita proizvodna sistema tokom 2017 godine – organskog i konvencionalnog. Sadržaj slobodnih (nevezanih) fenola i flavonoida određen je standardnim spektrofotometrijskim metodama po Folin-Ciocalteu, odnosno sa aluminijum-hloridom. Sadržaj polifenola izražen je kao mg ekvivalent galne kiseline (GAE) po kg suve mase uzorka, a sadržaj flavonoida kao mg ekvivalent kvercetina (QE) po kg suve mase uzorka. I sadržaj polifenola kao i flavonoida je bio veći u semenu konvencionalne soje u odnosu na organsku- 966.9 mg/kg GAE i 693.8 mg/kg GAE tj. 184.2 mg QE/kg i 113.8 mg QE/kg suve mase uzorka.

Determination of free polyphenol and flavonoids content in organic and conventionally produced soybean seed (*Glycine max* L.)

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Soybean, a legume from family *Fabaceae*, due to its high content of antioxidants provides antitumour and chemopreventive effects. The aim of this work was to detect the content of most important antioxidants – polyphenols and flavonoids in soybean seed gained from two different producing systems during 2017 season – organic and conventional. Content of free (not bound) fenolics and flavonoids was determined using standard spectrophotometric methods with Folin-Ciocalteu reagent and aluminium-chloride, respectively. Content of free polyphenolics was expressed as mg of galic acid equivalents (GAE) per kg of dry sample and free flavonoids content was expressed using mg of quercetin equivalents (QE) per kg of dry sample. Both polyphenolics and flavonoids content were higher in conventional soybean seed compared to organic- 966.9 mg/kg GAE and 693.8 mg/kg GAE i.e. 184.2 mg QE/kg and 113.8 mg QE/kg of dry mass.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP11 / FCHP11

Uticaj vakuum pakovanja na mikrobiološki kvalitet pečenog svinjskog mesa tokom skladištenja

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Jedna od najbitnijih funkcija toplotne obrade mesa je uništavanje mikroorganizama izazivača kvara i vegetativnih patogenih mikroorganizama, čime se produžava rok trajanja mesa i proizvoda od mesa. Broj uništenih mikroorganizama zavisi od odnosa vreme-temperatura i vrste mikroorganizama prisutnih na proizvodu. Odgovarajući način pakovanja, kao i hlađenje mogu usporiti razmnožavanje mikroorganizama, produžujući rok trajanja sa nekoliko dana na nedelju dana i više, svežeg kao i pečenog mesa. Cilj ovog rada je bio da se ispita uticaj vakuum pakovanja na mikrobiološku održivost pečenog svinjskog mesa tokom skladištenja u frižideru.
Uzorci *longissimus dorsi* mišića nabavljeni su u lokalnoj prodavnici. Uzorci su sečeni u odreske debljine 2 cm i pečeni u električnoj rerni na 163 °C, do dostizanja 71 °C u centru uzoraka. Nakon hlađenja na sobnu temperaturu, pečeni uzorci su zapakovani u plastične kutije, odnosno u prisustvu vazduha (kontrola C) i u vakuum vrećice (V) i skladišteni na 4 °C 21 dan.
Mikrobiološka ispitivanja su sprovedena 1, 3, 7, 14. i 21. dana skladištenja. Određen je ukupan broj aerobnih mezofilnih bakterija (UAMB), kvasaca (UBK), plesni (UBP), *E. coli*, sulfito-redukujućih klostridija (USRK), *Enterobacteriaceae* i sporogenih bakterija (USB).
UAMB na početku je bio 20 cfu/g, u C uzorcima. Nakon 7 dana skladištenja, C uzorci su imali veći broj UAMB (230000 cfu/g) u poređenju sa V uzorcima (60 cfu/g). UAMB je u V uzorcima 14. i 21. dana iznosio 85 i 20800 cfu/g, respektivno. UBK i UBP, kao i broj *Enterobacteriaceae*, bio je manji od 10 cfu/g tokom čitavog perioda skladištenja u C i V uzorcima. *E. coli* i USRK nisu detektovani tokom skladištenja ni u jednoj od ispitanih grupa uzoraka. USB u C uzorcima 1. dana skladištenja bio je manji od 10 cfu/g, kao i 3. i 7. dana u C i V uzorcima. USB u V uzorcima 14. i 21. dana skladištenja iznosio je 65 i 300 cfu/g, respektivno.
Dobijeni rezultati ispitivanja pokazali su da postoji pozitivan uticaj vakuum pakovanja na održivost pečenog svinjskog mesa.

Effect of vacuum packaging on microbiological quality of cooked pork during refrigerated storage

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Cooking performs a most important function by causing destruction of spoilage and vegetative pathogenic microorganisms, thus improving the storage life of meat products. The number of destroyed microorganisms will depend on the time and temperature relationship and the type of microorganism on the product. Proper packaging, along with refrigeration could slow down multiplication of microorganisms, extending the storage life from a few days to a week or more. The objective of the present study was to asess the effect of vacuum packaging on microbiological quality of cooked pork during refrigerated storage.
The *longissimus dorsi* muscles were obtained from a local store. The samples were cut into 2 cm thickness and cooked in an electric oven at 163 °C, until an internal temperature of 71 °C was reached. Following cooling to room temperature, cooked samples were packaged in food plastic boxes, i.e. in the presence of air (control C) and under vacuum in plastic bags (V) and stored at 4 °C for 21 day.
Microbiological examinations were performed on 1st, 3rd, 7th, 14th and 21st day of storage and they included determination of total count of aerobic mesophilic bacteria (AMBC), yeasts (TYC), molds (TMC), *E. coli*, sulphite-reducing clostridia (SRCC), *Enterobacteriaceae* and spore forming bacteria (SFBC).
AMBC at the beginning was 20 cfu/g, in C samples. After 7 days of storage, C samples showed higher AMBC (230000 cfu/g) than V samples (60 cfu/g). AMBC in V samples on day 14 and day 21 was 85 and 20800 cfu/g, respectively.
TYC and TMC was below 10 cfu/g throughout the entire storage period in C and V samples, as well as for *Enterobacteriaceae*. *E. coli* and SRCC were not detected during the storage period in both sample groups. SFBC in C samples on day 1 of storage was below 10 cfu/g, as on day 3 and 7 for C and V samples. SFBC detected on day 14 and 21 in V samples was 65 and 300 cfu/g, respectively.
This study shows that vacuum packaging is effective in reducing microbial growth in cooked pork during storage.

OHP12 / FCHP12

Metaboliti i degradacioni proizvodi pesticida – značaj kompjuterskih metoda u toksikološkoj proceni rizika od unosa putem hrane

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U poljoprivredi se svakodnevno koristi više od hiljadu pesticida u kontroli nepoželjnih organizama. Najčešće korišćeni pesticidi su: organofosfati, karbamati, piretroidi i ditiokarbamati. Nedavne izmene u regulativi, kojima se zahteva detekcija i kvantifikacija metabolita i degradacionih proizvoda pesticida, otvorile su nova pitanja prilikom procene rizika od unosa ovih supstanci putem hrane.
Iako se podaci o toksičnosti pesticida dobijaju putem studija na životinjama, još uvek nema dovoljno podataka o toksičnosti njihovih degradacionih proizvoda. Sa ciljem smanjenja broja studija na životinjama i dobijanja pouzdanih podataka, razvijeni su alternativni kompjuterski modeli. Jedan od njih je (Kvantitativni) odnos strukture i aktivnosti ((Quantitative) Structure-Activity Relationships, (Q)SAR). Derek Nexus, OECD QSAR Toolbox, Toxtree i VEGA-QSAR, su samo neki od mnogobrojnih (Q)SAR softvera koji se mogu koristiti u ovu svrhu.
DEREK Nexus je komercijalni sistem baziran na saznanju, koji generiše predviđanje o toksičnosti isipitivane hemikalije, uz detaljno obrazloženje dobijenih rezultata.
OECD QSAR Toolbox je besplatan softver čiji se rad zasniva na svrstavanju hemikalija u kategorije na osnovu njihove hemijske strukture. Ovaj softver sadrži korisne in silico modele (read-across, trend analysis i (Q)SAR models).
Toxtree aplikacija je zasnovana na Kramerovom drvetu odluke. Ono sadrži niz pitanja na koja se može odgovoriti sa „da" ili „ne", a vode svrstavanju hemikalije u jednu od tri grupe - niska, intermedijarna i visoka toksičnost.
VEGA-QSAR softver pruža desetine modela za procenu veoma značajnih svojstava hemikalija, kao što su perzistentnost, logP, biokoncentracioni faktor (BCF) itd.
Upotreba prikazanih softvera predstavlja prvi korak u proceni rizika od unosa pesticida putem hrane, sa ciljem da se dobiju preliminarni podaci, prevaziđu ograničenja proistekla usled nedostatka podatataka o potencijalnoj toksičnosti i usmere dalja istraživanja.

Computational methods in dietary risk assessment of metabolites/degradates of pesticides

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More than thousand pesticides are used in agriculture around the world, while the most common are: organophosphates, carbamates, pyrethroids, and dithiocarbamates. The recent refinement in requirements of pesticide risk assessments, including a detection and quantification of all their metabolites and degradates, opened up new questions about human dietary risk assessments. Although the toxicological properties of pesticides are predominantly obtained from the experimental animal studies, data on their breakdown products are limited. In order to reduce the number of animal studies and generate reliable data, alternative computational models, such as Structure-Activity Relationships (SARs) and Quantitative Structure-Activity Relationships (QSARs), have been developed. Some (Q)SAR software packages, such as Derek Nexus, OECD QSAR Toolbox, Toxtree, and VEGA-QSAR, could be useful for the purpose of prediction of potential toxicity.
Derek Nexus is a commercial knowledge-based expert system, which enables an overall conclusion about the likelihood of toxicity of an investigated structure including a detailed explanation of the output.
The OECD QSAR Toolbox is a freely available software application based on the chemical category approach, which includes useful in silico models (read-across, trend analysis and (Q)SAR models).
Toxtree is a user-friendly open source application, able to estimate toxic hazard by applying a decision tree approach, based on a series of yes-no questions in order to place substances in one of the three Cramer Classes based on their toxicity.
VEGA-QSAR software freely offers tens of models for properties such as persistence, logP, bioconcentration factor (BCF), carcinogenicity, mutagenicity, skin sensitization.
These computational methods could be used as a preliminary step in dietary risk assessment, to improve food safety and surpass the limitations in pesticide metabolites/degradates risk assessment.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP13 / FCHP13

Efekat *Bacillus safensis* 2.7 na promociju rasta odabranih poljoprivrednih kultura

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Bakterije koje promovišu rast biljaka (PGP) su grupa zemljišnih bakterija, u najvećem broju prisutnih u rizosferi, koje direktno i indirektno, pozitivno utiču na rast biljaka, hormonski status, otpornost na abiotičke i biotičke stresove.
Cilj rada bio je testiranje *B. safensis* 2.7 na prisustvo osobina koje mogu promovisati rast biljaka (rast u ekstremnim uslovima, produkcija indol- sirćetne kiseline, aktivnost ACC-deaminaze, sinteza egzopolisaharida, egzoenzima, antimikrobnih jedinjenja i produkcija biofilma), kao i ispitivanje efekta datog soja na klijanje semena i rast klijanaca odabranih poljoprivrednih kultura (paprika, pšenica, kukuruz, cvekla, rotkvica, paradajz i krastavac).
Na osnovu dobijenih rezultata može se zaključiti da *B. safensis* 2.7 ima sposobnost rasta u ekstremnim uslovima, kao i produkcije biofilma, produkuje indol-sirćetnu kisleinu, ima aktivan enzim ACC-deaminazu, ali nema sposobnost solubilizacije fosfata kao ni sposobnost produkcije egzopolisaharida i antimikrobnih supstanci. Ovaj soj je pokazao pozitivno dejstvo na dužinu izdanka paprike, rotkvice i paradajza, dok je kod pšenice i krastavca ispoljio negativan efekat na dužinu izdanka. Pozitivan efekat na dužinu korena ispoljio je kod rotkvice, dok je kod paprike, pšenice, kukuruza, cvekle i krastavca ispoljio negativan efekat. Pozitivan efekat na svežu masu klijanaca ispoljio je kod paprike i rotkvice, dok je negativan efekat ispoljio kod pšenice, kukuruza i krastavca. Kod paradajza nije primećen bilo kakav efekat na ispitivana svojstva klijanaca. Na osnovu izračunatih vrednosti za vigor semena može se zaključiti da *Bacillus safensis* 2.7 promotivno deluje na semena paprike i rotkvice.

The effect of *Bacillus safensis* 2.7 on growth promotion of selected agricultural important plant species

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Plant growth promoting bacteria (PGP) represent a group of bacteria, mainly from plant rhizosphere, able to directly or indirectly stimulate plant growth and regulate hormone balance as well as plant response to biotic and abiotic stress.
The aim of this work was testing the effect of *Bacillus safensis* 2.7 on seed germination and seedlings growth of selected agricultural important species (pepper, wheat, corn, beetroot, radish, tomato and cucumber) and testing of the ability of strain to grow in extreme conditions, as well as to produce indol-acetic acid, exopolysaccharides, exoenzymes, antimicrobial compounds, biofilm and ACC deaminase.
Accoridng to obtained results, we can conclude that *B. safensis* 2.7 is able to grow in extreme conditions and produces indol-acetic acid, biofilm and active ACC deaminase, but does not produce exopolysaccharides and antimicorbial compunds, and is not able to solubilize phosphate. Investigation of the effects on plants showed that the lenght of pepper, radish and tomato seedlings have been positively regulated by *B. safensis* 2.7, which was opposite in wheat and cucumber seedlings. Also, the promotive effect on rooth length was observed on pepper and radish seedlings. The investigated strain had a promotive effect on pepper and radish seedlings mass, but there was no effect on tomato seedlings. In addition, according the results from seed vigor testing and overall results, we can conclude that *Bacillus safensis* 2.7 has a promotive effect on pepper and radish.

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OHP14 / FCHP14

Uticaj etarskih ulja bosiljka i kima na makro- i mikromorfološke promene plesni izolovanih sa površine fermentisanih kobasica

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Poslednjih godina velika pažnja posvećena je primeni prirodnih antimikrobnih agenasa (kao što su ekstrakti i etarska ulja aromatičnih biljaka) u zaštiti hrane od mikrobiološke kontaminacije. Istaživanja ukazuju da značajan broj ovih jedinjenja pokazuje antimikrobni potencijal, međutim njihov način delovanja još uvek nije detaljno opisan. S toga je i cilj ovog rada baziran na ispitivanju uticaja etarskih ulja (EOs) bosiljka i kima na makro- i mikromorfološke promene plesni. Za ova ispitivanja odabrano je pet vrsta plesni iz roda *Penicillium* (*P. aurantiogriseum, P. carneum, P. cavernicola, P. nalgiovense* i *P. polonicum*) i jedna vrsta roda *Mucor* (*M. racemosus*), koje su izolovane sa površine fermentisanih kobasica. Ispitivanja su izvedena agar dilucionom metodom sa određivanjem minimalne inhibitorne (MIC) i minimalne fungicidne koncentracije (MFC). Makromorfološke promene plesni nastale pod uticajem etarskih ulja praćene su stereomikroskopom, a mikromorfološke "scanning" elektronskom mikroskopijom (SEM), korišćenjem elektronskog mikroskopa Joel, JSM-6460LV (Oxford, Instruments). EO kima pokazalo je bolje antifungalne efekte u odnosu na EO bosiljaka. MIC EO kima za *P. carneum* je bila 0,7 µl/ml, a za ostale ispitivane vrste 1,5 µl/ml. MIC EO bosiljka za *P. nalgiovense* i *P. polonicum* bila je 9,0 µl/ml a za ostale vrste 4,5 µl/ml. MFC EO kima za *P. aurantiogriseum* iznosila je 1,5 µl/ml, a za ostale vrste 4,5 µl/ml, dok je MFC EO bosiljka bila 9,0 µl/ml za *P. aurantiogriseum, P. carneum, P. cavernicola,* and *Mucor racemosus*. Pod uticajem EOs došlo je do makromorfoloških promena ispitivanih plesni koje su se ogledale u promeni teksture kolonije, u pigmentaciji i intentzitetu sporulacije. Mikromorfološke promene ukazivale su na deformaciji reproduktivnih struktura, konidiofora i hifa.

Effect of basil and caraway essential oils on macro- and micromorphological changes of moulds isolated from fermented sausages

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In recent years, great attention has been paid to the application of natural antimicrobial agents (such as extracts and essential oils of aromatic plants) in food. The researches indicate that a significant number of these compounds have antimicrobial potential, but mode of action of essential oils and extracts are not yet described in detail. Therefore, the aim of this study is based on the investigation of effects of basil and caraway essential oils (EOs) on macro- and micromorphological changes in moulds. Five species of moulds were chosen for antifungal tests, from the genus *Penicillium* (*P. aurantiogriseum, P. carneum, P. cavernicola, P. nalgiovense* and *P. polonicum*) and one species of genus *Mucor* (*M. racemosus*). Tested moulds were isolated from the surface of fermented sausages. Assays were carried out by agar dilution method with the determination of minimum inhibitory (MIC) and minimum fungicidal concentration (MFC). Macromorphological changes in moulds resulting from the effect of EOs were examined with stereomicroscope. Micromorphological changes in moulds were examined with scanning electron microscopy (SEM), using an electron microscope Joel, JSM-6460LV (Oxford, Instruments). Caraway EO showed better antifungal effects than basil EO. MIC of caraway EO for *P. carneum* was 0.7 µl/mL, and for other species 1.5 µl/mL. MIC of basil EO for *P. nalgiovense* and *P. polonicum* were 9.0 µl/mL, and for other species 4.5 µl/mL. MFC of caraway EO for *P. aurantiogriseum* was 1.5 µl/mL, and for other species 4.5 µl/mL, while MFC of basil EO was 9.0 µl/mL for *P. aurantiogriseum, P. carneum, P. cavernicola,* and *Mucor racemosus*. Macromorphological changes of investigated moulds were manifested as changes of colony color, texture and intensity of sporulation. Micromorphological changes were manifested as deformations of conidiophores, reproductive structures and hyphae.

OHP15 / FCHP15

Ocena znanja, stavova i ponašanja studenata veterinarske medicine u vezi sa upotrebom antibiotika

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Rezisitencija bakterija na antibiotike je direktno povezana sa nepravilnom upotrebom antibiotika i predstavlja jednu od najvažnijih pretnji za globalno javno zdravlje i bezbednost hrane. Iako je Srbija država sa dugom tradicijom visoke i neracionalne upotrebe antibiotika i obzirom da Globalni akcioni plan Svetske Zdravstvene Organizacije naglašava važnost edukacije zdravstvenih radnika o upotrebi antibiotika ipak do sada nisu sprovedena istraživanja o znanju studenata o upotrebi ove grupe lekova. Cilj ove studije je bio da se ispitaju znanje, stavovi i ponašanje studenata završnih godina veterinarske medicine u vezi sa upotrebom antibiotika. U anonimno ispitivanje je uključeno ukupno 72 studenta četvrte i pete godine smera veterinarske medicine. Prosečna starost ispitanika bila je 24,1 godina, dok ih je 44,4% bilo ženskog pola. Da se lečenje antibioticima započinje nakon posete lekaru uz dobijen lekarski recept tvrdilo je oko 66,7% ispitanika, što je u skladu sa brojem studenata koji su uzimali antibiotike po preporuci lekara tokom poslednje infekcije (70,8%). Oko 1,3% studenata je izjavilo da lečenje antibioticima započinje zalihama antibiotika koje već imaju kod kuće, što se slaže sa procentom studenata koji su prilikom poslednje infekcije uzimali antibiotik koji im je ranije lekar propisao. Čak 50% ispitanika je smatralo da se antibiotici koriste za lečenje prehlade. Da se lečenje antibioticima započinje na osnovu saveta farmaceuta smatralo je oko 2,8% studenata, a 18,1% da se antibiotici uzimaju do prestanka simptoma bolesti. Iako rezultati ispitivanja, pre svega nizak procenat samomedikacije, pokazuju da ispitanici imaju relativno dovoljno znanje o upotrebi antibiotika, uočeni su neki pogrešni stavovi i neodgovarajuća ponašanja studenata. Zbog toga, dalje obrazovne aktivnosti treba da budu usmerene na poboljšanje razumevanja rezistencije na antibiotike, kao i ponašanje studenata u vezi sa upotrebom antibiotika.

Assessment of the knowledge, attitudes and behaviours of veterinary medicine students towards antibiotic use

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Antimicrobial resistance is directly related to improper use of antibiotics and poses one of the most important threats to global public health and food safety. Although Serbia is a country with a long tradition of high and irrational antibiotic use and since Global Action Plan of the World Health Organization emphasizes the importance of educating health professionals about the antibiotic use, no research has been conducted to date on students' knowledge of the use of this group of drugs. The aim of this study was to examine the knowledge, attitudes and behaviour of final year veterinary students towards antibiotic use. An anonymous survey included the total of 72 veterinary students of the fourth and the fifth year. The average age was 24.1 years, and 44.4% of the respondents were female students. Roughly 66.7% of respondents claimed that the antibiotic treatment should be started after a visit to a medical doctor and receiving a prescription, which is in line with the number of students who obtained antibiotics with prescription from a medical doctor during the last infection (70.8%). Around 1.3% of the students said that they started their treatment with stocks of antibiotics already available at home, which is in line with the percentage of students who took the antibiotic that was prescribed by the medical doctor earlier, during the last infection. Even 50% of the respondents believed that antibiotics could be used to treat common colds. Around 2.8% of the students thought that treatment with antibiotics should be started on the basis of pharmacist's advice and 18% considered that antibiotics should be taken until disease symptoms disappear. Although the results of the study, primarily the low percentage of self-medication, demonstrated that respondents had relatively sufficient knowledge regarding the antibiotic use, some wrong attitudes and improper behaviour were identified. Therefore, further educational activities should be focused on improvement of the understanding of antibiotic resistance, as well as students' behaviour in relation towards antibiotic use.

OHP16 / FCHP16

Lipidni profil kao alatka za procenu autentičnosti semena gajenog i divljeg voća

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Ulje semena bobičastog voća je bogat izvor esencijalnih masnih kiselina i bioaktivnih komponenti, zbog čega se smatra proizvodom sa dodatom vrednošću koji se može uspešno koristiti kao funkcionalna hrana visokih nutritivnih svojstava. Zahvaljujući činjenici da se seme bobičastog voća može dobiti kao sporedni proizvod u industrijskoj proizvodnji potrebne su dodatne informacije o hemijskom sastavu semena različitih sorti voća. Cilj ovog rada je karakterizacija semena 74 različite sorte bobičastog samoniklog i gajenog voća iz Srbije na osnovu sadržaja lipida. Lipidna frakcija je analizirana normalno-faznom visoko-efikasnom tankoslojnom hromatografijom (HPTLC). Identifikovano je pet osnovnih klasa lipida: triacilgliceroli, diacilgliceroli, slobodne masne kiseline, polarni lipidi i steril-estri. HPTLC u kombinaciji sa multivarijantnom analizom slike i metodama prepoznavanja obrazaca, je korišćena za dobijanje lipidnog profila uzoraka i za klasifikaciju gajenog i divljeg voća, kao i različitih sorti bobičastog voća. Ova vrsta istraživanja može doprineti razlikovanju pojedinih kultura, kao i dobijanju informacija o markerima značajnim za procenu njihove autentičnosti.

Lipid profile as a tool for the assesment of authenticity of cultivated and wild fruit seeds

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Berry seed oils are considered as value added products that can be successfully used for functional and nutraceutical food products due to the high content of essential omega fatty acids and bioactive compounds. Regarding the fact that berry seeds can be obtained as a byproduct from processing companies more information of cultivar`s seeds and its composition are required. The aim of this work is to characterize berry seeds from 74 different genuine Serbian wild and cultivated fruits species/cultivars by evaluation of their lipids composition. The total lipids were analyzed by normal-phase high preformance thin-layer chromatography (HPTLC). Identified lipids are divided in five major fractions: triacylglycerols, diacylglycerols, free fatty acids, polar lipids and steryl esters. HPTLC combined with multivariate image analysis, and pattern recognition methods, were used for fingerprinting and classification of cultivated and wild fruits, and berries cultivars. This kind of investigation may contribute for the inter-cultivar discrimination and enhancing the possibilities of acquiring an important authenticity factor.

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OHP17 / FCHP17

Uticaj dodatka hitozana i proteina surutke u alginatni matriks namenjen inkapsulaciji probiotika na svojstva nosača

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Cilj ovog rada je ispitivanje efekta dodatka proteina surutke i hitozana u alginatni matriks namenjen za inkapsulaciju probiotske starter kulture metodom elektrostatičke ekstruzije. Alginat je široko korišćen nosač „GRAS“ standarda koji se pokazao kao izuzetno pogodan za inkapsulaciju probiotika. Procesom umrežavanja proteina i alginata nastaju protein-alginatne čestice (WPA), dok hitozan-alginatne čestice (CA) nastaju procesom oblaganja alginatnih čestica (AL) slojem hitozana. Probiotska starter kultura inkapsulirana u WPA pokazuje značajno veći porast broja ćelija tokom procesa fermentacije (1,501 logCFU/g) poredeći sa CA (1,290 logCFU/g) i AL (1,125 logCFU/g). Titracijska kiselost i pH imaju približne vrednosti. Takođe, WPA pokazuje 5 puta veće otpuštanje ćelija tokom fermentaciju nego AL, a 6 puta veće nego CA. Uzrok većeg ćelijskog rasta i otpuštanja za WPA je veća poroznost matriksa u odnosu na AL i CA, što je posledica interakcija alginata i proteina surutke. Ove interakcije su dokazane FTIR analizom. Dodatkom hitozana mehanička svojstav matriksa uvećana su za 0.699N, a dodatkom proteina surutke za 0,212N. Tokom procesa fermentacije mehanička svojstva uvećana su za 0,21N kod AL, odnosno 0,091N kod CA, dok su u slučaju WPA ova svojstva uvećana za 0,568N. Ovakva mehanička svojstva kao i dobijeni spektri FTIR analize pokazuju da povećanje čvrstine čestica tokom fermentacije nastaje kao posledica interakcije proteini surutke sa jonima Ca iz supstrata, kao i rekombinovanja u strukturi matriksa koje se javlja kao posledica metaboličke aktivnosti inkapsulirane kulture, a koje je izraženije kod WPA. Sveobuhvatno, različiti dodaci u alginatni matriks uzrokuju različite promene. Tako, dodatak hitozana ima za posledicu povećanje čvrstine čestica kao i smanjenje otpuštanja ćelija iz matriksa, dok dodatak proteina surutke utiče na metaboliču aktivnost kulture što vodi većem broju ćelija nakon fermentacije, ali i većim promenama u strukturi matriksa.

Effect of chitosan and whey protein addition in alginate matrix used for probiotic encapsulation on carrier properties

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The aim of this paper is to show effect of whey protein and chitosan addition in alginate matrix to properties of carrier obtained by electrostatic extrusion. Alginate is a wildly used GRAS standard carrier who shows many benefits for probiotic encapsulation. Whey protein–alginate beads (WPA) are formed through a cross-linking process between proteins and alginate, while chitosan-alginate beads (CA) were obtained by coating an alginate beads (AL). Probiotic starter culture encapsulated in WPA showed higher increase in cell number during fermentation (1.501 logCFU/g) compared to CA (1.290 logCFU/g) and AL (1.125 logCFU/g), while pH and titratable acidity showed similar changes. Also, WPA showed 5 times higher cell release during fermentation than AL, and 6 times than CA. Higher cell growth and cell release for WPA indicate higher porosity as a result of major changes in matrix caused by whey protein addition. This changes confirmed by mechanical and FTIR analysis. Mechanical properties of alginate matrix with addition of chitosan increase for 0.699N compared to 0.212N for whey protein addition. Also, mechanical properties of AL and CA increase for 0.21N and 0.091N during fermentation, compared to 0.568N for WPA. This results indicate that proteins builds bonds with calcium ions from whey, what has positive effect on the beads hardness, but also it can be concluded that probiotic starter culture changed structure of matrix during fermentation what leads to re-bonding which is more pronounced in whey proteins containing beads. FTIR fingerprint before and after fermentations showed larger changing in WPA compared to CA and AL. In general, different additions positively influence the different beads properties. Chitosan addition significantly enhances the strength of beads and reduces cell release, while whey proteins significantly increase fermentation activity of encapsulated culture what leads to significant increase in cell number and grate changes in matrix during fermentation.

OHP18 / FCHP18

Optimizacija uslova ultrazvučne ekstrakcije fenolnih jedinjenja ploda divlje maline (*Rubus Idaeus* L.): HPLC-PDA analiza i određivanje antioksidativne aktivnosti dobijenog ekstrakta

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Cilj ovog rada bila je optimizacija uslova ultrazvučne ekstrakcije za određivanje sadržaja ukupnih fenola, flavonoida i antocijana u ekstraktu ploda divlje maline (*Rubus Idaeus* L.), HPLC-PDA analiza ekstrakta dobijenog pod optimalnim uslovima, kao i njegov antioksidativni kapacitet. Uslovi koji su optimizovani su procenat metanola (v/v %), odnos mase uzorka i zapremine rastvarača (g/mL), vreme ekstrakcije (min) i temperatura ekstrakcije (°C). Na osnovu eksperimentalnog dizajna i softverskog paketa Design Expert 7.0.0., određeni su optimalni uslovi ove vrste ekstrakcije i to su: procenat metanola 20% (v/v %), odnos mase uzorka i rastvarača 0,01 g/mL, vreme ekstrakcije 15 min i temperatura 80 °C. Nakon izvršene ekstrakcije pod nađenim optimalnim uslovima, određen je sadržaj ukupnih fenola (383,0 mg GAE/100 g svežeg ekstrakta), flavonoida (37,60 mg RU/100 g svežeg ekstrakta) i antocijana (15,90 mg CGE/100g svežeg ekstrakta). Dalje je izvršena HPLC-PDA analiza dobijenog ekstrakta u cilju identifikacije i kvantifikacije prisutnih fenolnih jedinjenja. Identifikovana jedinjenja su antocijani cijanidin-3-glukozid i cijanidin-3-soforozid, flavonoidi katehin i epikatehin i elaginska kiselina. Takođe je ispitana i antioksidativna aktivnost ekstrakta divlje maline primenom DPPH i ABTS metode. Ekstrakt je pokazao aktivnost od 28,99 µmol Troloxa/g ekstrakta primenom DPPH metode, a primenom ABTS testa, ova aktivnost je iznosila 39,47 µmol Troloxa/g ekstrakta.
Ovi rezultati daju značajne informacije o efikasnosti ekstrakcije bioaktivnih jedinjenja u cilju njihove analize i mogu podstaknuti širu upotrebu i konzumiranje ove vrste voća kao važnog prirodnog izvora bioaktivnih jedinjenja.

Optimization of ultrasonic extraction conditions of phenolic compounds in the wild raspberry extract (*Rubus Idaeus* L.): HPLC-PDA analysis and antioxidant activity determination of the obtained extract

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The aim of this study was the optimization of extraction conditions of total phenolic compounds, flavonoids and anthocyanins in wild raspberry (*Rubus Idaeus* L.) extract, HPLC-PDA analysis of extract obtained under optimal conditions as well as its antioxidant capacity. The conditions that were optimized were: methanol percentage (v/v %), solid to liquid ratio (g/mL), time (min) and extraction temperature (°C). Based on experimental design and Design Expert 7.0.0. software package, optimal conditions were obtained – methanol percentage 20% (v/v %), solid to liquid ratio 0.01 g/mL, extraction time 15 min and extraction temperature 80 °C. After extraction obtained under optimal conditions, contents of total phenolics (383.0 mg GAE/100 g FW), flavonoids (37.60 mg RU/100 g FW) and anthocyanins (15.90 mg CGE/100 g FW) were determined. The extract was further analysed by HPLC-PDA with the aim of identifying and quantifying present phenolic compounds. Identified compounds were anthocyanins cyanidin-3-glucoside and cyanidin-3-sophoroside, flavonoids epicatechin and catechin and ellagic acid. At the end, DPPH and ABTS tests were used to determine antioxidant capacity of the wild raspberry extract. The extract showed DPPH radical scavenging activity of 28.99 µmol Trolox/g extract, while ABTS radical scavenging activity was 39.47 µmol Trolox/g extract.
These results provide valuable information about effective extraction of bioactive compounds for their analysis and could encourage wider usage and consumption of this fruit as an important natural source of bioactive compounds.

OHP19 / FCHP19

Preliminarno ispitivanje sastava masnih kiselina u sterilizovanom i pasterizovanom mleku

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Mleko se smatra jedinom od najkompletnijih namirnica u pogledu sastava i nutritivne vrednosti. Nutritivni značaj kravljeg mleka i potencijalni efekti na ljudsko zdravlje mogu se pripisati njegovim glavnim sastojcima kao što su proteini, masti, vitamini i mineralne materije. Sastav masnih kiselina u mlečnoj masti je vrlo složen, jer zavisi od različitih faktora kao što su način uzgoja i naročito način ishrane muznih životinja.
Cilj ovog rada bio je ispitivanje sastava masnih kiselina u devet uzoraka mleka, od čega su bila 2 pasterizovana i 7 uzoraka sterilizovanog mleka, sa 1,5-3,2 % mlečne masti (mm). Analiza masnih kiselina (MK) urađena je pomoću gasne hromatografije (GC) sa plameno-jonizujućim detektorom (GC-FID) posle derivatizacije BF_3/MeOH reagensom. U uzorcima pasterizovanog mleka uočena je veća raznovrsnost masnih kiselina u poređenju sa uzorcima sterilizovanog mleka. Zasićene masne kiseline (ZMK) bile su zastupljenije u odnosu na nezasićene masne kiseline (NMK). Palmitinska kiselina detektovana je u svim uzorcima mleka sa učešćem od 27,7-100, 0%, miristinska kiselina u osam uzoraka (17,91-35,48 %), a stearinska u sedam uzoraka mleka (11,9-22,9 %). Mononezasićene kiseline, miristoleinska i □-9 masne kiseline (oleinska i elaidinska) detektovane su u četiri uzorka mleka, dok su polinezasićene masne kiseline,□□-3 (*cis*-11,14,17-eikozatrienoinska kiselina), □-6 (*cis*-8,11,14-eikozatrienoinska kiselina) i □-6 *trans* (linolelaidinska kiselina) detektovane samo u jednom uzoku pasterizovanog mleka. Najveći broj masnih kiselina (14 ZMK i 4 NMK) detektovan je u uzorku pasterizovanog mleka sa 1,6 % mm, dok je u uzorku sterilizovanog mleka sa 1,6 % mm detektovana samo palmitinska kiselina.

Preliminary Assessment of Fatty Acids Composition in Sterilized and Pasteurized Milk

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Milk is considered to be one of the most complete foods in terms of composition and nutritional value. Nutritional importance of cow milk and potential effects on human health could be attributed to its main ingredients such as fats, proteins, vitamins and minerals. The composition of fatty acids in milk fat is very complex, because it depends on various factors such as breeding method and especially diet of dairy cattle.
This work aimed to determine the fatty acids composition in nine milk samples, 2 of which were pasteurized and 7 samples of sterilized milk, with 1.5-3.2% milk fat (mf). Fatty acid analyses were performed by gas chromatography (GC) with flame ionization detector (GC-FID) after derivatization with BF_3/MeOH reagent.
A greater heterogeneity of fatty acids was observed in pasteurized samples, in comparison with samples of sterilized milk. Saturated fatty acids (SFA) were more pronounced compared to unsaturated fatty acids (UFA). Palmitic acid was detected in all milk samples (27.7-100.0 %), whereas myristic acid and stearic acid were detected in eight (17.91-35.48 %) and seven milk samples (11.9-22.9 %), respectively. Monounsaturated acids, miyistoleic and□□-9 fatty acids (oleic and elaidic) were detected in four milk samples, while polyunsaturated fatty acids, ω-3 (*cis*-11,14,17-eicosatrienoic acid), ω-6 (*cis*-8,11,14-eicosatrienoic acid) and□□-6 *trans* (linolelaidic) were detected only in one sample of pasteurized milk. The highest number of fatty acids (14 SFA and 4 UFA) was found in the pasteurized milk with 1.6 % mf. On the other hand, in the sample of sterilized milk with 1.6 % mf only palmitic acid was detected.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP20 / FCHP20

Efekat nanočestica CeO_2 obloženih polisaharidima na rast i ukupni sadržaj fenola kao parametar stresa kod dve vrste useva

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Cerijum oksid nanočestice ($nCeO_2$) se istražuju u velikoj meri zbog jedinstvene sposobnosti- izmene između Ce^{3+} u Ce^{4+} oksidacionih stanja, što im omogućava višestruku primenu, kao što su katalizatori, elektrolitički materijal u akumulatorima, za transport lekova u organizmu, u poljoprivredi (đubriva, pesticidi) itd. Uprkos ovim činjenicama, glavno ograničenje primene $nCeO_2$ je njihova sklonost taloženju, što je mnoge istraživače navelo da ih oblažu različitim polimerima. Međutim, literaturni podaci o uticaju obloženih nanočestica na metabolizam biljke su oskudni. Takođe, povećana primena $nCeO_2$ postaje rizik za životnu sredinu zbog njihove akumulacije u zemljištu, vazduhu i vodi. Toksičnost metala može dovesti do prekomerne proizvodnje reaktivnih kiseoničnih vrsta (ROS) uzrokujući abiotički stres i oštećenje važnih bioloških molekula u usevima.

U ovom istraživanju klijanci pšenice i graška su tretirani tokom tri nedelje u hidroponici sa 200 mgL^{-1} neobloženih i glukozom-, levanom- i pululanom obloženih $nCeO_2$ (G-CeO_2, L-CeO_2 and P-CeO_2). Cilj je bio ispitati uticaj oblaganja nanočestica na usvajanje Ce, rast i promenu ukupnog sadržaja fenola (TPC), kao indikatora oksidativnog stresa u usevima monokotila i dikotila. ICP-OES je korišćen za određivanje koncentracije Ce u nadzemnim delovima tretiranih useva, dok je TPC određen Folin-Ciocalteu-ovom spektrofotometrijskom metodom.

Među tretiranim usevima, usvajanje Ce je bilo različito. Povećano usvajanje Ce je zabeleženo nakon oblaganja u grašku, a smanjeno u pšenici. Visok sadržaj Ce detektovan u pšenici je uzrokovao povećano izdužavanje nadzemnog dela bez efekta na TPC. Sa druge strane, nizak sadržaj Ce izmeren u grašku nije imao uticaja na izdužavanje nadzemnog dela, kao ni na TPC.

Prikazani rezultati pokazuju razlike u usvajanju $nCeO_2$ i njihov efekat na rast biljke bez uticaja na fenolni metabolizam. Uprkos ovim činjenicama, neophodno je dalje istraživanje.

Effect of polysaccharide coated CeO_2 nanoparticles on growth and total phenolic content as a stress parameter of two crop species

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Cerium oxide nanoparticles ($nCeO_2$) have been widely investigated because of their unique property - transition between Ce^{3+} and Ce^{4+} oxidation states which allows them multiple applications, such as a catalyst, an electrolyte material in fuel cells, for drug delivery, in agriculture (fertilizer, pesticides) etc. Despite these facts, the main restriction of $nCeO_2$ application is their tendency for agglomeration, which led many researchers to coat them with different polymers. However literature data about the impact of coated nanoparticles on plant metabolism are scarce. Also, enhanced $nCeO_2$ application has become the risk for the environment due to their accumulation in soil, air and water. Metal toxicity may lead to an overproduction of reactive oxygen species (ROS) causing the abiotic stress and damage of important biological molecules in crop species.

In current research, we performed a three week treatment of wheat and pea seedlings in hydroponics with 200 mgL^{-1} uncoated and glucose-, levan- and pullulan coated $nCeO_2$ (G-CeO_2, L-CeO_2 and P-CeO_2). Our goal was to study the impact of nanoparticles coating on Ce uptake, plant growth and on changes in total phenolic content (TPC), as an indicator of oxidative stress, in monocotyledonous and dicotyledonous crop species. ICP-OES was used for determination of Ce concentration in shoots of treated crop species, while TPC was determined by Folin-Ciocalteu's spectrophotometric method.

The uptake of Ce was different among the treated crop species. Ce uptake was increased after coating in pea, but decreased in wheat. The high Ce content detected in wheat caused the increase in shoot elongation without the effect on TPC. On the other hand, low Ce content measured in pea, had no influence on shoot elongation as well as on TPC. Presented results indicate the difference in $nCeO_2$ uptake and their effect on plant growth without the impact on phenolic metabolism. Despite these results, further research is necessary.

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OHP21 / FCHP21

Mineralni profil odabranih kupusnjača (*brassica oleracea*) proizvedenih organskom tehnologijom gajenja

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Organska tehnologija gajenja je sve zastupljenija u proizvodnji povrća. Povrće iz familije Brassicaceae poznato je po svom antikancerogenom dejstvu, zahvaljujući visokom sadržaju sumpornih glikozida. Cilj rada bio je odredjivanje esencijalnih elemenata Na, K, Mg, Ca, Fe, S i P u odabranim kupusnjačama: kupusu (*Brassica oleracea* var. *capitata*), brokoliju (*Brassica oleracea* var. *silvestris*), prokelju (*Brassica oleracia* var. *gemmifera*) i kelerabi (*Brassica oleracea* var. *gongylodes*), proizvedenih organskom tehnologijom gajenja. Sadržaj elemenata određen je primenom analitičke tehnike induktivno kuplovana plazma sa optičkom emisionom spektrometrijom (ICP–OES). Analizirani elementi detektovani su u koncentracijama od 3,7 mg/kg (Fe) do 3832,5 mg/kg (K), sa izuzetkom Fe koje nije detektovano u kelerabi. Najveći sadržaj Ca, Fe i P detektovan je u brokoliju, K u kelerabi, Na u kupusu, a Mg i S u prokelju. Rezultati ukazuju da je ispitivano povrće dobar izvor kalijuma, kalcijuma i fosfora.

Mineral Profile of Selected Brassicas (*Brassica Oleracea*) Grown in the Organic Production System

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Organic farming technology is becoming increasingly present in the production of vegetables. Vegetables from the family *Brassicaceae*, have been known for their anticancer properties, due to the high content of sulfuric glycosides. The aim of this study was to determine the essential elements Na, K, Mg, Ca, Fe, S i P, in selected *brassicaceae*: cabbage (*Brassica oleracea* var. *capitata*), broccoli (*Brassica oleracea* var. *Silvestris*), brussels sprout (*Brassica oleracia* var. G*emmifera*) and kohlrabi (*Brassica oleracea* var. *Gongylodes*), grown in organic production technology. Content of elements was determined using analytical technique of inductively coupled plasma with optical emission spectrometry (ICP–OES). In studied vegetables, analyzed elements were detected at concentrations of 3.7 mg/kg (Fe) to 3832.5 mg/kg (K), with the exception of Fe in kohlrabi (not detected). The highest content of elements was as follows: Ca, Fe and P in broccoli, K in kohlrabi, Na in cabbage, Mg and S in brussels sprout. The results of the study indicate that the studied vegetables are a good source of potassium, calcium and phosphorus.

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OHP22 / FCHP22

Promotivni potencijal odabranih sojeva *Bacillus* spp. na klijanje semena paprike

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Neki sojevi koji pripadaju rodu *Bacillus* su okarakterisani kao bakterije koje promovišu rast biljaka (PGP) kroz povećanje klijanja semena, mase korena, mase klijanaca ili ukupne mase klijnca. Takođe prisustvo PGP bakterija olakšava biljkama da prežive uslove biotičkog i/ili abiotičkog stresa. Cilj ovog istraživanja bio je selekcija sojeva koji imaju PGP potencijal i praćenje njihovog efekta na klijanje semena paprike. Kolekcija od 220 prirodnih izolata *Bacillus* spp. je analizirani na sposobnost rasta u ekstremnim uslovima kao što su povišena temperatura (50°C), suša (30% PEG6000), visoka koncentracija soli (7% NaCl). Šest izolata koji su mogli da rastu u sva tri tipa analiziranih uslova su dalje testirani na sposobnost sinteze indol-sirćetne kiseline, aktivnost ACC-deaminaze, sintezu egzopolisaharida, egzoenzima, antimikrobnih jedinjenja i formiranje biofilma, a zatim je praćen njihov efekat na klijanje semena i rast klijanaca paprike. Korišćenjem prajmera za *tuf* gen ovi sojevi su identifikovani kao: *Bacillus safensis* 2.7, *Bacillus velezensis* 6.4, *Bacillus thuringiensis* 29.2, *Bacillus velezensis* 8.2.2, *Bacillus licheniformis* 30.3 i *Bacillus paralicheniformis* 37.5. Dobijeni rezultati su pokazali da osim rasta u ekstremnim uslovima koji karakteriše sve sojeve, soj *B. safensis* 2.7 formira jak biofilma i ima najveću produkuciju indol-sirćetne kiseline. Svi testirani sojevi imaju aktivan enzim ACC-deaminazu, ali nemaju sposobnost solubilizacije fosfata kao ni sposobnost produkcije egzopolisaharida i antimikrobnih supstanci. Rezultati dobijeni analizom efekta ovih šest sojeva na dužinu korena, dužinu klijanaca, masu korena, masu klijanaca i ukupnu masu klijanaca paprike su pokazali da najbolje rezultate daje soj *Bacillus safensis* 2.7. Ovaj soje je imao najbolji efekat na dužinu i masu korena, dok je soj *Bacillus paralicheniformis* 37.5 pkazao najlošije rezultate za sve analizirane parametre.

Plant growth promoting effect of selected *Bacillus* spp. strains on pepper seed germination

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Some strains from genus *Bacillus* are characterized as plant growth promoting (PGP) bacteria since they have ability to promote seed germination or increase of root and seedlings mass, or total mass of seedlings. In addition, PGP bacteria are able to facilitate plant growth in the conditions of biotic and abiotic stress. Aim of this study was to select strains with PGP potential and to analyze their effect on pepper seed germination. Growth in extreme conditions such as heat stress (50°C), resistance to salinity (7% NaCl) and drought tolerance (32% of PEG6000) was tested in collection of 220 natural isolates from genus *Bacillus*. Six isolates with ability to grow in all analyzed extreme conditions were tested on production of indol-acetic acid (IAA), exopolysaccharides, exoenzymes, antimicrobial compounds, biofilm production and ACC deaminase activity. Their effect on pepper seed germination and growth of pepper seedlings was also analyzed. All strains were identified with primers for *tuf* gene as *Bacillus safensis* 2.7, *Bacillus velezensis* 6.4, *Bacillus thuringiensis* 29.2, *Bacillus velezensis* 8.2.2, *Bacillus licheniformis* 30.3 and *Bacillus paralicheniformis* 37.5. Obtain results showed that except growth in extreme conditions which is characteristic for all strains, strain *Bacillus safensis* 2.7 is strong biofilm producer and has the highest IAA production. All tested strains have an active ACC-deaminase enzyme but do not have the ability to solubilize phosphate, to produce exopolysaccharide and antimicrobial substances. Results obtained by analyzing the effect of these six strains on the root and seedlings length, mass of root and seedlings, and the total mass of the pepper seedlings showed that the best results are obtained with strain *Bacillus safensis* 2.7. This strain had the best effect on the length and root mass, while strain *Bacillus paralicheniformis* 37.5 showed the poorest results for all analyzed parameters.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP23 / FCHP23

Emulgujuća svojstva vlakana šećerne repe i OSA maltodekstrina u prehrambenim sistemima

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Emulzije su termodinamički nestabilni sistemi i zahtevaju prisustvo emulgatora. Savremena istraživanja upućuju na mogućnost primene prirodnih jedinjenja u ulozi emulgatora, npr. amfifilnih proteina ili polisaharida. Potencijalni izvori ovih komponenti su sporedni proizvodi agroindustrije, s obzirom na njihovu biopolimernu makromolekulsku prirodu, koja se može uklopiti u prehrambene proizvode. Cilj ovog rada je ispitivanje mogućnosti primene prirodnih polisaharida u ulozi emulgatora u emulzionim prehrambenim sistemima tipa ulje u vodi. Korišćena su vlakna šećerne repe (SBF) i modifikovani skrob OSA–maltodekstrin (OSAm) u koncentracijama 0,5 i 1%.
Primena OSAm u emulzijama ukazala je na dobra emulgujuća svojstva ovog polisaharida, jer je porast koncentracije doprineo smanjenju veličina kapi. Dovoljna količina emulgatora sposobnog da se adsorbuje na površinu kapi sprečila je pojavu koalescencije kapljica ulja. Primenom većih koncentracija SBF smanjuje se Span vrednost, što ukazuje na užu raspodelu veličina kapi. Kriming indeks emulzija sa SBF je niži u poređenju sa emulzijama koje sadrže OSAm. Stabilizujući efekat SBF u emulzijama pripisuje se povećanju viskoznosti kontinualne faze nakon dodatka i porasta sadržaja polisaharida (η_{rel} se povećava). Takođe, pripisuje se i prisustvu polarnih i nepolarnih grupa aminokiselinskih ostataka, koji zaostaju u strukturi vlakana šećerne repe. Mogući scenariji formiranja stabilizujućeg efekta SBF matriksa su: kapi ulja su inkorporirane u gel strukturu hidratisanog makromolekula, ili se javlja tzv. „pickering" efekat najmanjih čestica SBF ili se stabilzacija ostvaruje zahvaljujući postojanju lipofilnih proteinskih centara na površini SBF vlakana.
Primenjeni prirodni polisaharidi pokazali su odličan potencijal stabilizacije emulzija, čime se otvara mogućnost primene ovih prirodnih ingredijenata u ulozi emulgatora, sa ciljem zamene sintetičih aditiva u prehrambenim proizvodima.

The emulsifying properties of sugar beet fibers and OSA maltodextrin in food systems

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Emulsions are thermodynamically unstable systems and require an emulsifier. Recent reports indicated possibility of application of some natural compounds in the role of emulsifiers, e.g. amphiphilic proteins or polysaccharides. Potential sources of these components are agro–industry by–products, due to their biopolymer macromolecular structure that can be incorporated into the food products. The aim of this work was to investigate the application of natural polysaccharides in the role of emulsifiers in food systems with O/W emulsions. The sugar beet fibers (SBF) and modified starch OSA-maltodextrin (OSAm) in concentrations of 0.5 and 1% were used.
Applied OSAm showed excellent emulsifying properties, because its increased concentration contributed to reducing of oil droplets size. Sufficient amount of emulsifier capable to adsorb on the surface of the droplets prevented the occurrence of coalescence. Application of higher concentration of the SBF reduced the Span value, indicating to narrow droplets size distribution. Creaming index of emulsions with SBF is lower compared to emulsions containing OSAm. The stabilizing effect of the SBF is attributed to increased viscosity of the continuous phase after addition of polysaccharides and after increase in their concentration (η_{rel} is increased). Also it is attributed to the presence of polar and non–polar groups of the amino acid residues, which remain in the structure of sugar beet fibers. Possible scenarios of stabilizing effect of SBF matrix are: oil droplets are incorporated into the gel structure of hydrated macromolecules, or the so-called "pickering" effect of the smallest particles of SBF occurred or stabilization is achieved due to lipophilic protein centers on the surface of SBF fibers.
Applied polysaccharides have shown excellent potential of emulsions stabilization, which opens the possibility for application of these natural ingredients in the role of emulsifier, in order to replace synthetic additives in food products.

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OHP24 / FCHP24

Šećerni profil kao pokazatelj uticaja tetraoksana na metabolizam kukuruza u ranim fazama rasta i razvića

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U ovom radu ispitan je uticaj serije 1,2,4,5-tetraoksana na metabolizam klijanja u ranim fazama rasta i razvića kukuruza. Primenom visoko-efikasne jonske hromatografije sa amperometrijskom detekcijom analiziran je sadržaj šećera u korenu i izdanku kukuruza, čija semena su bila potopljena u rastvore tetraoksana koncentracija 1×10^{-6} M, 1×10^{-9} M i 1×10^{-12} M. Sadržaj analiziranih šećera ukazuje na različit odgovor biljke na prisustvo svakog od ispitivanih tetraoksana. Uočeno je da dolazi do povećanja sadržaja gotovo svih šećera u tretiranim uzorcima, u odnosu na kontrolne, a naročito šećera koji povećavaju toleranciju biljke na abiotski stres, kao što su glukoza, saharoza, rafinoza, trehaloza i arabinoza. Za svaki od ispitivanih tetraoksana mogu se definisati optimalne koncentracije koje bi imale najveći uticaj na pravilan rast i razviće kukuruza.

Sugar profile as a tool for the assesment of influence of tetraoxanes on germination and starting growth phase of maize seeds

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The influence of the series of 1,2,4,5-tetraoxanes on metabolism of germination and starting growth phase of maize seeds was examined. Sugar content in shoot and root of seeds immersed in tetraoxane solution of different concentration, 1×10^{-6} M, 1×10^{-9} M i 1×10^{-12} M, were determined by High-Performance Anion-Exchange Chromatography with Pulsed Amperometric Detection. The content of all analysed sugars revealed different responce of the plant to the presence of each of the tested tetraoxanes. It has been observed a higher content of almost all sugars in the treated samples, compared to control, and especially sugars which increase the tolerance of the plant to abiotic stress, such as glucose, sucrose, raffinose, trehalose and arabinose. The optimal concentration of each tested compound that would have the greatest effect on proper growth and development of maize, could be defined.

OHP25 / FCHP25

Optimizacija mikrotalasne ekstrakcije polifenola iz *Mentha piperita* L. primenom metode odzivne površine

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Pitoma nana (*Mentha piperita* L.) je višegodišnja biljka iz familije Lamiaceae, široko rasprostranjena po celom svetu. Tradicionalno se koristi u ishrani i lečenju zbog svojih lekovitih efekata. Za dobijanje tečnih ekstrakata pitome nane, korišćena je tehnika mikrotalasne ekstrakcije. Cilj ovog rada je optimizacija procesa mikrotalasne ekstrakcije odnosno određivanje optimalnih procesnih parametara koji daju najveći prinos ekstrakcije, prinos ukupnih fenola i ukupnih flavonoida. Za optimizaciju procesa korišćen je centralno-kompozitni eksperimentalni dizajn za ispitivanje uticaja između tri nezavisno promenljiva parametra (koncentracija etanola, vreme ekstrakcije i odnos droga/rastvarač) na tri nivoa. Dizajn se sastojao iz 19 eksperimenata sa 5 ponavljanja u centralnoj tački. Svi eksperimenti su izvršeni pri konstantnoj snazi mikrotalasnog zračenja (800 W). Optimizacija je izvršena upotrebom metode odzivne površine (RSM - Response Surface Methodology).

Optimization of microwave-assisted extraction of polyphenols from *Mentha piperita* L. by response surface methodology

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Peppermint (*Mentha piperita* L.) is a perennial plant from Lamiaceae family, widespread throughout the world. It is traditionally used as a medicinal plant due to its beneficial health effects. Microwave-assisted extraction was used for preparation of peppermint liquid extracts. The aim of this work was optimization of the microwave assisted extraction process, i.e. determination of the optimal process parameters that should provide the highest total extraction yield, including total phenols and total flavonoids in liquid extracts. The Central-composite experimental design has been used for determination of independent variables influence (ethanol concentration, extraction time and sample-solvent ratio). The design consisted of 19 experiments with five replicates at central point. All experiments were performed at constant microwave irradiation power (800 W). Process optimization was performed by response surface methodology (RSM).

Određivanje polifenolnog i šećernog profila organski gajene cvekle

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Cvekla (*Beta vulgaris)* se danas smatra najkorisnijom i najlekovitijom povrtarskom kulturom koja sadrži veliku količinu biološki aktivnih komponenti koje povoljno utiču na zdravlje ljudi. Razlike između konvencionalne i organske proizvodnje mogu da utiču na hranljive vrednosti biljaka. Polifenoli, prirodni antioksidansi, su od posebnog značaja zbog pozitivnog dejstva na zdravlje ljudi. Kako bi se postigla maksimalna iskorišćenost hranljivih materija, obraća se posebna pažnja čvrstoj materiji (trop) koja zaostaje u industrijskoj preradi cvekle. Cilj ovog rada je određivanje koncentracije ukupnih polifenola, antioksidativne aktivnosti kao i polifenolnog i šećernog profila tropa od organski gajenih cvekli. Tokom rada optimizovan je proces ekstrakcije korišćenjem rastvarača sa različitim udelom etanola, od 20 do 70%. Koristeći spektroskopske metode, određen je sadržaj ukupnih polifenola, kao i antioksidativna aktivnost ispitivanih uzoraka. Šećeri u tropu cvekle su određeni korišćenjem *HPAEC-PAD* tehnike, dok su upotrebom *UHPLC-DAD MS/MS* sistema identifikovani i kvantifikovani pojedinačni fenoli.

Determination of sugar and polyphenolic profile of organic beetroot

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Beetroot (*Beta vulgaris*) is considered as the most useful and effective vegetable culture, which contains a large amount of biologically active components that can give benefit to human health. Differences between conventional and organic production can affect nutritional values of plants. Polyphenols, natural antioxidants, are very important due to the positive effect on human health. In order to achieve the maximum utilization of nutrients, special attention is paid to solid matter (pomace) that is remain after industrial beet processing. The framework of this research is to determine the content of total polyphenols, the antioxidant activity and the polyphenolic and sugar profile of beetroot pomace from organic cultivated beets from Serbia. The extraction process was optimized using solvents with a different proportion of ethanol, from 20 to 70 %. The total polyphenol content and the antioxidative activity in beetroot extracts were determined by spectroscopic method. Sugars in the pomace beetroot were determined using the HPAEC-PAD technique, while using the UHPLC-DADMS/MS system individual phenolic compounds were identified and quantified.

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OHP27 / FCHP27

Mikrosladovanje tritikalea

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Tritikale (*Triticosecale* spp) je kao prva sintetička biljka nastao ukrštanjem pšenice (*Triticum* spp.) i raži (*Secale* spp.). Karakteristike ove žitarice omogućavaju njegovu upotrebu kao zamene ječmenog slada u proizvodnji piva. Tritikale je otporniji u poređenju sa drugim žitaricama. Može da se kultiviše na marginalnim i kiselim zamljištima, što smanjenjuje troškove proizvodnje u poređenju sa drugim žitaricama. Nesladovane sirovine koje se najčešće koriste kao zamena ječmenog slada u proizvodnji piva nemaju enzimski potencijal. Tritikale se izdvaja visokom amilolitičkom aktivnosti pojedinih sorti, čak i u nesladovanom obliku, što je bio slučaj i u našim ispitivanjima. Niska temperatura klajsterizacije (59–65°C) omogućava razgradnju skroba na temperaturnom režimu komljenja sličnom ječmenom sladu. Pentozani i β-glukani doprinose povećanoj viskoznosti sladovine i sporijoj filtraciji piva. U tritikaleu su β-glukani manje zastupljeni, dok se ćelijski zid uglavnom sastoji od pentozana, što je potvrđeno u našem ispitivanju. Cilj rada je utvrđivanje mogućnosti primene tritikalea kao delimične zamene ječmenog slada u proizvodnji sladovine, na osnovu analiza tritikalea i slada tritikalea, sa osvrtom na praćenje aktivnosti α-i β-amilaze i sadržaja β-glukana i pentozana tokom sladovanja. Obe sorte tritikalea, NS Paun i Odisej, su imale sličan sadržaj β-glukana u nativnom zrnu, kao i u dobijenom sladu. Obe sorte su imale visoku aktivnost α-amilaze u sladu, posebno sorta Odisej (259,42U/g). Takođe, obe sorte su imale povećan sadržaj pentozana. Sladovi obe sorte su imali visok sadržaja ekstrakta (88 i 84%) i dijastatsku snagu (520 and 550°WK). Slad proizveden od obe sorte tritikalela imao je dobre tehnološke parametre kvaliteta i može se koristiti kao delimična zamene ječmenog slada u proizvodnji sladovine.

Triticale micromalting

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Triticale (*Triticosecale* spp.) the first man-made cereal, is the product of a cross between wheat (*Triticum* spp.) and rye (*Secale* spp.). This cereal complies very well with the requirements for brewing adjuncts. Being an environmentally more flexible than the other cereals, triticale can grow on marginal, high acid soils, which can reduce production costs in comparison to other cereals. The most common brewing adjuncts usually do not contribute enzyme activity. Triticale is superior in this respect since some triticale varieties already have high levels of amylolytic activity even in the unmalted form, which was confirmed in our research. Low gelatinization temperature (59–65°C) enables starch solubilisation and amylolysis during mashing by applying temperature regimes similar to those for barley malt. Pentosans and β-glucan contribute to wort viscosity and increase beer filtration rate. When using triticale, β-glucans are negligible, while the cell walls contain predominantly pentosans, which was also the case in our research. The objective of this study was to evaluate the possibility of triticale application as partial substitute for barley malt in wort production. Analyzed were both the triticale and the produced malts for amylase activity, β-glucan and pentosans content during the malting process. During micromalting, both examined varieties NS Paun and Odisej, had similar β-glucan content in native grain and in the malt. α-Amylase activity in obtained malts was increased in both varieties, especially in variety Odisej (259.42U/g). Also, both varieties had increased pentosans content during micromalting. Produced malt had very high extract content (88 and 84%) and diastatic power (520 and 550°WK). Triticale malts had good technological quality parameters and could be used as a partial substitute for barley malt in wort production.

OHP28 / FCHP28

Uticaj vidljivog i UVB zračenja na *in vitro* stabilnost hlorofilina (E141) u vodenom medijumu

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Hlorofilin je polusintetički derivat hlorofila. Zbog dobre rastvorljivosti u vodi često se koristi kao boja u prehrambenoj industriji (aditiv-E141), aktivna komponenta lekova, kao i katalizator za zarastanje rana. Najčešći oblici hlorofilina su derivati natrijuma i bakra. Studije sprovedene na životinjama pokazale su da dopuna ishrane hlorofilinima može smanjiti štetu nastalu hemijskim kancerogenima i zračenjem. Zbog toga je od velike važnosti njegova stabilnost prema UVB zračenju i vidljivoj svetlosti. Degradacija hlorofilina kao posledica vidljivog i UVB zračenja u vodenom mediju ispitana je *in vitro* UV-VIS spektrofotometrijom pri različitim koncentracijama pigmenta. Kontinualna UVB zračenja sa maksimom emisije na 300 nm, i zračenja vidljivim svetlom vršena su u cilindričnim fotohemijskim reaktorima. Ukupni izmereni fluks koji uzorci primaju iznosio je oko 15,0 Vm^{-2} za oba tipa zračenja. Rezultati pokazuju postepenu degradaciju hlorofilina s povećanjem perioda zračenja. Degradacije hlorofilina od 20 % postignuta je posle 300 min vidljivog i 25 min UVB zračenja pri koncentraciji pigmenta od 5×10^{-6} M. Uticaj koncentracije na foto oksidacioni stres nije primećen u slučaju hlorofilina, što ukazuje na to da se hlorofilin ne ponaša asocijativno u vodenom mediju (pri koncentracijama od 10^{-6}-10^{-4} M). Rezultati pokazuju da je stres izazvan UV-B zračenjem veći u poređenju sa oksidativnim stresom izazvanim vidljivim zračenjem. Eksperimentom potvrđenu fotosenzitivnost hlorofilina treba uzeti u obzir prilikom dizajna i optimizacije prehrambenih i farmaceutskih proizvoda kako bi se postigli mogući pozitivni efekti njegove upotrebe.

Influence of visible and UVB irradiation on *in vitro* chlorophylline (E141) stability in aqueous medium

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Chlorophyllin is a semi-synthetic derivative of chlorophyll. Due to good solubility in water it is often used as colorant in the food industry (additive - E141), the active drug compound as well as catalyst for wounds healing. The most common chlorophyllin forms are sodium and copper derivatives. Studies conducted on animals indicated that chlorophyllin supplementation can reduce the damage inflicted by chemical carcinogens and radiation. Therefore, its stability to UVB radiation and visible light is of a great importance. Chlorophyllin degradation as a consequence of visible and UVB radiation in an aqueous medium was examined *in vitro* by UV-VIS spectrophotometry at different pigment concentrations. Continuous UVB irradiation with emission maxima at 300 nm, and visible light irradiation were carried out in cylindrical photochemical reactors. The total measured energy flux (hitting the samples) was about 15.0 Wm^{-2} for both irradiation types. Results showed the gradual chlorophyllin degradation with increasing irradiation period. The chlorophyllin degradation of 20 % was achieved after 300 min of visible and 25 min of UVB irradiation at the pigment concentration of 5×10^{-6}M. The concentration influence on photo oxidation stress has not been observed in the case of chlorophyllin, which indicate that the chlorophyllin is not behaving associative in aqueous medium (in the investigated concentrations range of 10^{-6}-10^{-4} M). The results showed that stress caused by UV-B irradiation is more destructive compared to visible oxidative stress. Chlorophyllin instability reported in this work may limit its use in potential commercial products.

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OHP29 / FCHP29

Proizvodnja fermentisanog mlečnog napitka sa probiotičkom kulturom *Lactobacillus helveticus* BGRA43

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Pored nutritivnih vrednosti, mlečni fermentisani proizvodi predstavljaju izvor bioaktivnih peptida sa antibakterijskim, antikancerogenim, antihipertenzivnim i imunomodulatornim efektima. Pored komercijalnih starter kultura za proizvodnju mlečnih fermentisanih proizvoda se sve češće koristite prirodni izolati bakterija mlečne kiseline sa probiotičkim svojstvima. Uloga probiotika se ogleda u uspostavljanju ravnoteže crevne mikrobiote, lakšem varenju hrane i/ili sprečavanju kolonizacije patogena. Tokom fermentacije, degradacijom proteina mleka, dolazi i do oslobađanja esencijalnih aminokiselina. U ovoj studiji je korišćena komercijalna starter kultura za proizvodnju jogurta koja sadrži *Lactobacillus delbrueckii* ssp. *bulgaricus* i *Streptococcus thermophilus*, u kombinaciji sa probiotičkom kulturom *Lactobacillus helveticus* BGRA43. Fermentacija je urađena u tri nezavisne serije: "R" (fermentacija sa BGRA43), "Y" (fermentacija sa komercijalnom jogurtnom kulturom) i "YR" (fermentacija sa jogurtnom kulturom i BGRA43, u odnosu 1:1). Cilj ove studije je bio da se analizira efekat BGRA43 na kvalitet proizvoda, produkcija mlečne kiseline i pH, kao i da se pokaže aminokiselinski profil i broj bakterija mlečne kiseline (BMK) tokom skladištenja na 4°C u trajanju od 21 dan. Takođe, sprovedena je senzorska analiza proizvoda sedmog i 14. dana nakon proizvodnje. Produkcija mlečne kiseline je najviša u "R" seriji, a najniža u seriji "Y". Tokom skladištenja na 4°C u trajanju od 21 dan pH je najniži u "R" seriji (4.07±0.02), dok je u serijama "Y" i "YR" bio 4.36±0.02 i 4.31±0.1. Ukupan broj laktobacila i streptokoka tokom skladištenja se smanjio za jedan log. Aminokiselinski profil je pokazao da serija "R" sadrži veće koncentracije esencijalnih aminokiselina od serija "Y" i "YR". Dobijeni proizvodi su senzorno testirani od strane 33 analitičara sedmog i 14. dana nakon proizvodnje. Najbolji senzorni rezultati su zabeleženi za seriju "YR" sedmog dana nakon proizvodnje.

Production of dairy beverage with probiotic culture Lactobacillus helveticus BGRA43

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In addition to nutritional values, dairy products are the source of bioactive peptides with antibacterial, anticancer, antihypertensive, and immunomodulatory effects. Recently, the use of artisanal probiotic cultures in the production of dairy products, besides commercial starter cultures, is becoming common. Their role is reflected in the establishment of microbial balance in the intestine, easier digestion of food and/or prevention of pathogen colonization. During fermentation, by degradation of milk proteins, the release of essential amino acids occurs. In this study, commercial yoghurt starter culture including *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus* were used, together with the probiotic strain *Lactobacillus helveticus* BGRA43. Fermentation was done in three independent series: "R" (fermentation with BGRA43), "Y" (fermentation with commercial yoghurt cultures) and "YR" (fermentation with yoghurt culture and BGRA43, in a ratio of 1:1). The aim of this study was to investigate the effect of BGRA43 on product quality, lactic acid production, and pH, and to show the amino acid profile and the number of lactic acid bacteria during storage at 4°C for 21 days. Also, a sensory analysis of products on the 7th and 14th day after production was carried out. Lactic acid production is highest in the "R" series and the smallest in the "Y" series. During storage at 4°C for 21 days the pH was lowest in the "R" series (4.07±0.02), while in the "Y" and "YR" series 4.36±0.02 and 4.31±0.1, respectively. The total number of lactobacilli and streptococci during storage was reduced by one log. The amino acid profile showed that the "R" series contains higher concentrations of essential amino acids from the "Y" and "YR" series. Analyses of sensory properties of the obtained products were performed by 33 analysts on the 7th and 14th day after production. The best sensory results were recorded for the "YR" series on the 7th day after production.

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OHP30 / FCHP30

Stabilizacija apo-alfalaktalbumina prilikom vezivanja epigalokatehin-3-galata: eksperimentalno i molekulsko dinamičko proučavanje

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α-Laktalbumin (ALA) je mali, kiseli, Ca^{2+}-vezujući protein koji može sačinjavati i do 20% proteina surutke. ALA se može naći u više delimično uvijenih intermedijernih stanja. U kiseloj sredini i na povišenoj temperaturi apo-oblik ALA se ponaša kao klasična "stopljena globula", te je interesantno proučavati njegove osobine i strukturu pri prelasku u stanja slična stopljenoj globuli.

Cilj ovog istraživanja bio je ispitivanje vezivanja epi-galokatehin-3-galata (EGCG) za apo-oblik ALA (bez Ca^{2+} jona), kao i za njegova manje uređena stanja. Dodatno je ispitan uticaj ovog polifenola na stabilizaciju apo-ALA. Eksperimentalni rezultati ovog ispitivanja su upotpunjeni molekulsko dinamičkim simulacijama.

Katehin iz zelenog čaja se vezuje za apo-ALA u neutralnim i kiselim uslovima. Studija gašenja fluorescencije proteina je pokazala da je afinitet vezivanja sličnog reda veličine kao i kod holo oblika ovog proteina. EGCG-ALA kompleks je u neutralnim uslovima pri termalnoj denaturaciji stabilniji od samog proteina, pri čemu je stabilišući faktor više izražen kod apo-ALA nego kod holo-ALA.

Simulacije molekulskog dokinga i molekulske dinamike (MDS) pokazale su da se EGCG vezuje za isto mesto kod apo-ALA i holo-ALA, u hidrofobnoj šupljini, između α i β subdomena, gde se i zadržava tokom čitave molekulsko dinamičke simulacije. Uklanjanje Ca^{2+}-jona dovodi do smanjene stabilnosti ALA sa lokalnom destabilizacijom Ca^{2+}-vezivnog regiona i blagim otvaranjem hidrofobne šupljine. Prilikom vezivanja EGCG za apo-ALA povećava se stabilnost proteina pri čemu se vraća stabilnost i konformacija Ca^{2+}-vezujućeg regiona. Ponovno uspostavljena stabilnost Ca^{2+}-vezujućeg regiona prenosi se i na hidrofobnu šupljinu što dovodi do njenog zatvaranja. EGCG može otežati prelazak apo-ALA u manje uredjena stanja u uslovima koji to favorizuju.

Stoga, nekovalentno vezivanje EGCG može stabilizovati strukturu ALA kojoj je Ca^{2+}-jon uklonjen.

Stabilization of apo-alpha-lactalbumin by binding of epi-gallocatechin-3-gallate: experimental and molecular dynamics study

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α-Lactalbumin (ALA) is a small, acidic, Ca^{2+}-binding protein that might constitute up to 20% of whey protein. ALA has several partially folded intermediate states. It is very attractive for studies of the properties and structure of intermediate molten globule-like states since at acidic pH and in the apo-state at elevated temperatures ALA is the classic 'molten globule'.

The aim of our study was to examine if epi-gallo-catechin-3-gallate (EGCG) binds to ALA in its Ca-depleted (apo-ALA) and less ordered states. Moreover we examined if the polyphenol binding can stabilize protein structure. The experimental investigation of EGCG binding and protein's stability were supported by molecular dynamics data.

Green tea catechin binds to apo-ALA in neutral and acidic conditions. Binding affinity determined by intrinsic fluorescence quenching is of a similar magnitude as to the holo form of the protein. The complex of EGCG and ALA at neutral conditions is more stable to thermal denaturation then protein alone. The stabilizing effect is more pronounced for apo-ALA than for the holo-ALA.

The docking analysis and molecular dynamic simulation (MDS) showed that EGCG binds to apoALA at the same site as to holoALA, in the hydrophobic pocket at the entrance of cleft between α and β subdomains, remaining bound during MDS. Ca^{2+} removal results in decreased conformational stability of ALA, where local destabilization of Ca^{2+}-binding region propagates to cleft, with its slight opening. EGCG binding to apo-ALA increases stability of ALA by reverting of conformation and stability of disturbed Ca^{2+}-binding region, which is transmitted to cleft, resulting in rejoining of α and β subdomains and slight cleft closing by the same mechanism. EGCG binding could retard transition of apo-ALA to less ordered states under conditions favoring its formation.

Therefore, non-covalent binding of EGCG can stabilize structural fold of calcium-depleted ALA.

OHP31 / FCHP31

Uticaj podloge na fenolni sastav i antiosidativnu aktivnost plodova sorti šljive

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Ispitivan je uticaj tri vegetativne podloge (Fereley, Pixy i St. Julien A) i sejanaca džanarike kao kontrole na fenolni sastav i antioksidativnu aktivnost plodova (odvojeno pokožice i mesa) kod tri sorte šljive (Čačanska lepotica, Čačanska rana i Čačanska najbolja). Ukupan sadržaj fenolnih jedinjenja (UF) i ukupan sadržaj antocijana (UA) određen je pomoću UHPLC-DAD MS/MS tehnike, a antioksidativna aktivnost (AA) pomoću DPPH testa. Najviše vrednosti za TPC, TAC i AA u pokožici ploda utvrđene su kod sorte Čačanska najbolja na podlozi džanarika. S druge strane, najniže vrednosti za iste parametre utvrđene su kod sorte Čačanska lepotica na podlozi Fereley. Među podlogama, najviše vrednosti za TF, TA i AA u pokožici ploda utvrđene su kod sejanaca džanarike. U odnosu na pokožicu, meso ploda je imalo 12,7 puta manji sadržaj UF i 3,7 puta nižu AA. Najviše vrednosti za TPC i AA u mesu ploda utvrđene su kod sorte Čačanska lepotica na podlozi St. Julien A, dok su one bile najniže kod sorte Čačanska rana na podlozi džanarika. Među podlogama, najviše vrednosti za TPC i AA u mesu ploda registrovane su kod podloge St. Julien A. Između UF i AA utvrđeni su statistički značajni koeficijenti korelacije (0,93 za pokožicu i 0,80 za meso ploda). U plodu šljive kvantifikovano je 27 različitih fenolnih jedinjenja, a u pokožici ploda je registrovano 9 antocijana.

Influence of rotstocks on phenolic composition and antioxidant activity of fruits of plum cultivars

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The influence of three clonal rootstocks ('Fereley', 'Pixy' and 'St. Julien A') and Myrobalan seedlings as a control on phenolic composition and antioxidant activity of fruits (skin and flesh separately) of three plum cultivars ('Cacanska Lepotica', 'Cacanska Rana' and 'Cacanska Najbolja') was studied. Total phenolics content (TPC) and total anthocyanin content (TAC) determined by the UHPLC–DAD MS/MS technique while antioxidant activity (AA) using DPPH test. The highest values for TPC, TAC and AA in the fruit skin were found in the 'Cacanska Najbolja' cultivar on the Myrabolan seedling rootstock. On the other hand, the lowest values for the same parameters were determined for the 'Cacanska Lepotica' cultivar on the 'Fereley' rootstock. Among rootstocks, the highest values for TPC, TAC and AA in the fruit skin were determined in Myrabolan seedlings. In relation to the skin, fruit flesh had 12.7 times lower TPC content and 3.7 fold lower AA. The highest values for TPC and AA in the fruit flesh were found in the 'Cacanska Lepotica' cultivar on the 'St. Julien A' rootstock, while they were the lowest in the 'Cacanska Rana' cultivar on the Myrabolan seedling. Among rootstocks, the highest values for TPC and AA in the flesh were registered in 'St. Julien A' rootstock. Between TPC and AA, statistically significant correlation coefficients were found (0.93 for skin and 0.80 for flesh). In the plum fruit, 27 different phenolic compounds have been quantified, and 9 anthocyanins were determined in skin.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP32 / FCHP32

Karakteristike grožđa i vina pet klonova sorte merlo u beogradskom rejonu, Srbija

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Klonska selekcija vinove loze je doprinela većoj raznolikosti i prilagodljivosti poboljšanih kvantitativnih i kvalitativnih karakteristika sorti. Tipičan primer je sorta Merlo. U Bordou postoji oko 300 potencijalnih klonova, 13 je priznato i široko je rasprostranjeno u svetu. I u drugim zemljama vršena je klonska selekcija sorte Merlo. U našem eksperimentu uključili smo klonove R12, R5 i I-ISV-F-V4 iz Italije, i dva klona 181 i 348 koji potiču iz Bordoa. Pored prinosa, zanimali su nas kvalitet, pokazatelji sastava grozda i bobice, kao i kvalitet vina. U toku tri godine ispitivanja najveći prinos postignut je kod klona R3, po jedini površine od jednog hektara i iznosio je 5700 kg. U isto vreme ovaj klon je pokazao najmanju varijabilnost u ispitivanom periodu. Klon 348 imao je izuzetno mali broj grozdova, samo 9,73 po čokotu. Prosečan broj grozdova po čokotu bio je ujednačen kod klonova R12, R3, I-ISV-F4 i 181 i iznosio je 19. Veći grozd sa manje semenki u bobici i nizak sadržaj ukupnih kiselina je karakterističan za klon I-ISV-F-V4, dok je sadržaj šećera u širi kod klona R12 bio najveći (22,2%). Razlike u kvalitetu vina između klonova bile su najizraženije u sadržaju ukupnih polifenola, alkohola i ukupnog ekstrakta. Vremenski uslovi u periodu ispitivanja (2013-2015) bili su značajno različiti i uticali su na kvalitet grožđa i vina ispitanih klonova.

Fruit and wines characteristics of the five merlot clones in Belgrade winegrowing region, Serbia

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Clonal selection has contributed more variety and adaptability improved quantitative and qualitative characteristics of the grapevine. The Merlot variety is a typical example. In Bordeaux keeps about 300 potential clones, 13 were approved and widely diversity in the world. In other countries was conducted clonal selection of the Merlo variety. In our experiment we included clones R12, R5 and I-ISV-F-V4 from Italy, and two clones 181 and 348, which are originating from Bordeaux. In addition to the yield, we showed quality, and the structure of the bunches and berries, and quality of wines. In three years the highest yield achieved the clone R3, per unit area of one hectare was 5700 kg. At the same time this clone showed the least variability in the examined period. The clone 348 had an extremely low number of bunches, only 9.73 per vine. The average number of bunches per vine was uniform at clones R12, R3 I-ISV-F4 and 181, about 19 bunches per vine. Bigger bunch with low seeds in berry and low total acid in the must is characteristic of the clone I-ISV-F-V4, while the sugar content in the must in clone R-12 is the highest (22.2%). The differences in the quality of the wines between clones were most pronounced in the content of total polyphenols, alcohol and total extracts. The weather conditions in the investigation period (2013-2015) were significantly different and affected the quality of grapes and wine of the investigated clones.

OHP33 / FCHP33

Uticaj dodatka starter kulture na boju tradicionalne fermentisane suve kobasie (*Petrovská klobása*)

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U ovom radu ispitan je uticaj dodatka komercijalne starter kulture na boju fermentisane suve kobasice (*Petrovská klobása*) proizvedene u tradicionalnim uslovima. Na kraju procesa sušenja ispitane su dve grupe kobasica: T-kobasice proizvedene na tradicionalan način bez dodatka starter kulture i S-kobasice proizvedene sa dodatkom komercijalne starter kulture (*Lactobacillus sakei*-25%, *Pediococcus pentosaceus*-25%, *Staphylococcus carnosus*-25%, *Staphylococcus xylosus*-25%). Instrumentalni pokazatelji boje (CIE *L*a*b** sistem: svetloća boje-*L**; udeo crvene boje-*a**; udeo žute boje-*b**; nijansa boje-h; zasićenost boje-*C** i odnos crvene i žute boje-R) su utvrđeni na svežem preseku kobasica. Za određivanje instrumentalnih pokazatelja boje korišćen je kolorimetar Minolta Chroma Meter CR-400. Takođe, formirana boja na preseku kobasica je ocenjena senzorski. Senzosku analizu boje izvršilo je 10 obučenih ocenjivača koji su koristili kvantitativno-deskriptivnu skalu intenziteta od 1 do 5 (1-neprihvatljiva boja; 5-optimalna boja). *Petrovská klobása* sa dodatkom komercijalne starter kulture imala je statistički značajno veći (P<0.05) udeo crvene boje *(a*)* i zasićenost boje *(C*)* u poređenju sa kobasicama kontrolne grupe. Takođe, dodatak starter kulture uticao je i na bolju senzorsku ocenu boje (T-3.78 i S-4.64), jer su kobasice ove grupe imale intenzivniju crvenu boju u poređenju sa kobasicama proizvedenim na tradicionalan način. Ova istraživanja ukazuje da dodatak komercijalne starter kulture ima pozitivan uticaj na instrumentalne i senzorske karakteristike boje *Petrovačke kobasice*.

Effect of starter culture addition on colour characteristic of traditional dry fermented sausage (*Petrovská klobása*)

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The aim of this study was to determine the effect of starter culture addition on colour characteristic of dry fermented sausage *Petrovská klobása* produced in traditional conditions. Two groups of sausages were examined at the end of drying period: T-sausages produced on traditional way without starter culture and S-sausages produced with starter culture (*Lactobacillus sakei*-25%, *Pediococcus pentosaceus*-25%, *Staphylococcus carnosus*-25%, *Staphylococcus xylosus*-25%) addition. The instrumental colour characteristic (CIE *L*a*b** system: lightness-*L**; redness-*a**; yellowness-*b**; hue angle-h; chroma-*C** and ratio of redness over yellowness-R) were determined on the fresh cut of sausages using the MINOLTA Chroma Meter. Sensory colour characteristics of sausages were evaluated by a panel of 10 trained panellist using scale from 0 to 5 (0-atypical colour; 5-optimal colour). According to the results obtained in this study, *Petrovská klobása* made with addition of starter culture had significantly higher (P<0.05) redness (*a**) and *C** value compared to sausages of control group. Also, addition of starter culture resulted in better sensory score (P<0.05) for colour (T-3.78 and S-4.64), because sausages of this group had more intensive and saturated red colour compared with sausages processed in traditional manure. The starter culture addition had positive effect on the instrumental and sensory characteristics of *Petrovská klobása* colour.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP34 / FCHP34

Uticaj dodatka etarskog ulja korijandera na oksidativnu stabilnost barenih kobasica

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U ovom radu ispitan je uticaj dodatka etarskog ulja korijandera na oksidativnu stabilnost i senzorni kvalitet barenih kobasica tokom 60 dana čuvanja. Proizvedene su 3 grupe kobasica: sa dodatkom 0,075 i 0,150 µl/g korijandera, kao i kobasice kontrolne grupe. Oksidativna stabilnost kobasica praćena je preko TBARS vrednosti (mg MDA/kg). Tokom 60 dana čuvanja u svim ispitivanim uzorcima došlo je do statistički značajnog (p<0,05) povećanja TBARS vrednosti. Dodatak etarskog ulja korijandera uticao je statistički značajno (p<0,05) na smanjenje TBARS vrednosti. Sa druge strane dodatak etarskog ulja korijandera nije imao negativnog uticaja na senzorna svojstva mirisa i ukusa barenih kobasica. Rezultati ovoga rada ukazuju na značajan uticaj etarskog ulja korijandera na povećanje antioksidativne aktivnosti i produženje održivosti barenih kobasica.

The Effects of Coriander Essential Oil on the Oxidative Stability of Cooked Pork Sausages

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The effects of coriander essential oil (CEO) on the oxidative stability and sensory quality of cooked pork sausages during 60 days of storage were evaluated. Sausages with two concentrations of CEO (0.075 and 0.150 µl/g) and control were prepared. Oxidative stability was quantificated using the TBARS values (mg MDA/kg). Significant increase of TBARS values were observed in all sausages after 60th day of storage. The addition of CEO significantly (p<0.05) reduced TBARS values. At the other hand, coriander essential oil addition had no negative impact on sensory properties of odour and taste of cooked pork sausages. Hence, the results of this study showed significant antioxidative activity of coriander essential oil and potential of its utilization in production of cooked pork sausages in order to prolong their shelf life.

OHP35 / FCHP35

Enološki parametri u karakterizaciji vina: studija klonske selekcije sorte kaberne fran

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Cilj ovog rada bio je određivanje enoloških parametara četiri uzorka vina (standard i tri klonska kandidata /02, 010 i 012/) sorte kaberne fran porekom iz Republike Srbije (uzgajane na poljoprivrednom oglednom dobru "Radmilovac" u Beogradu), pripremljena pod istim uslovima. Među 13 određenih parametara (koji uključuju ukupne i isparljive kiseline, pH, pepeo, ukupni ekstrakt, sadržaj alkohola, redukujuće šećere, aldehide, estre i tanine) posebna pažnja na posterskoj prezentaciji biće posvećena sadržaju neisparljivih organskih kiselina, tj. vinske, jabučne, sirćetne, limunske i mlečne kiseline.

Enological parameters in wine characterisation: The case study of Cabernet Franc clonal selection

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The aim of this study was to determinate a number of enological parameters of four samples (standard and three clone candidates /Nos. 02, 010 and 012/) of Cabernet Franc wines from the Republic of Serbia (grown at the agricultural experimental field "Radmilovac" in Belgrade), prepared under the same conditions. Among 13 tested parameters (which include both total and volatile acids, pH, ash, total extract, alcohol content, reducing sugars, aldehydes, esters and tannins) particular attention in the poster presentation will be given to the content of nonvolatile organic acids, i.e. to tartaric, malic, acetic, citric and lactic acids.

OHP36 / FCHP36

Uticaj dodavanja konjugovane linolne kiseline u hranu za nosilje na masnokiselinski sastav žumanceta

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Cilj ovog rada bio je da se ispitaju mogućnosti deponovanja konjugovane linolne kiseline (CLA) i promene masnokiselinskog profila u žumancetu jaja koka nosilja hranjenih sa dodatkom CLA tokom četiri nedelje eksperimenta. 40 koka nosilja podjednako je podeljeno u dve grupe, gde je kontrolna grupa hranjena potpunom krmnom smešom za ishranu koka nosilja, a ogledna grupa je dobijala istu hranu uz dodatak 2% CLA. Analize masnokiselinskog sastava, po 12 žumanceta svake grupe, vršene su nultog i 28. dana gasnom hromatografijom. Na početku eksperimenta (nultog dana) u obe grupe nisu uočene značajne promene u sadržaju zasićenih, mononezasićenih i polinezasićenih masnih kiselina, dok CLA nije detektovana. Nakon 28 dana sadržaj zasićenih masnih kiselina je bio značajno viši u oglednoj (59,83%), u poređenju sa kontrolnom grupom (33,16%), dok je sadržaj mononezasićenih masnih kiselina bio značajno niži u oglednoj (22,61%) u odnosu na kontrolnu grupu (53,36%) (P<0,01). Sadržaj polinezasićenih masnih kiselina 28. dana eksperimenta se kretao od 12,25% (kontrola) do 17,38% (ogledna grupa) (P<0,01). Konjugovana linolna kiselina nije detektovana 28. dana u uzorcima žumenceta kontrolne grupe, dok je u oglednoj grupi iznosila 4,28%. Dodatak konjugovane linolne kiseline nije uticao na konzumaciju hrane.
Značaj ovih rezultata je što ukazuju na to da ishranom koka nosilja možemo kontrolisati sadržaj željenih masnih kiselina u jajetu kao krajnjem proizvodu za ishranu ljudi.

Ključne reči: CLA, masne kiseline, koke nosilje, žumance jajeta

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Effect of dietary conjugated linoleic acid on egg yolk fatty acid profile in laying hens

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The aim of this study was to examine the possibility of conjugated linoleic acid (CLA) depositing and fatty acid profile changing in egg yolks of laying hens fed with CLA during four weeks of experiment. 40 laying hens were randomly divided into two groups, control group fed with feed mixture of standard chemical composition for laying hens and experimental group fed with the same feed with added 2% CLA. Fatty acid composition of 12 egg yolks from each group were analysed at the beginning and 28th day of the experiment by gas chromatography. At the beginning of experiment there were not any changes at saturated, monounsaturated and polyunsaturated fatty acid composition and conjugated linoleic acid was not detected. After 28 days of experiment, the content of saturated fatty acids was significantly higher in experimental group (59.83%), compared to the control group (33.16%), while the content of monounsaturated fatty acids were significantly lower in experimental (22.61%) than in control group (53.36%) (P<0.01). The content of polyunsaturated fatty acids at 28th day of experiment were from 12.25% (control) to 17.38% (experimental group) (P<0.01). Also, as expected, CLA was not detected at 28th day in the control group, while in the experimental group was 4.28%. Feed intake wasn't influenced by added CLA.
This study showed that dietary modifications could lead to nutritionally favorable changes in the fatty acid composition of egg yolks that are products for human consumption.

Keywords: CLA, fatty acids, laying hens, egg yolk

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY
OHP37 / FCHP37

Uticaj liofilizacije na kvalitet i antioksidativni kapacitet jagodastog voća

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Jagodastog voće je bogat izvor fitonutrijenata i bioaktivnih jedinjenja koja imaju visok antioksidativni kapacitet i pokazuju korisno dejstvo na zdravlje ljudi. Kratak period branja i osetljivost na biohemijske i mikrobiološke promene nakon berbe ograničavaju period dostupnosti jagodastog voća u svežem stanju. Jagodasto voće se zato konzerviše i prerađuje da bi bilo dostupno tokom cele godine. Sušenje može da se koristi da bi se produžilo vreme upotrebe jagodastog voća i omogućilo njihovo skladištenje na sobnoj temperaturi. Međutim, sušenje može da dovede do gubitka nutritivnih i senzornih osobina hrane. Liofilizacija je metod sušenja koji se zasniva na sublimaciji vode iz zamrznutog proizvoda. Kvalitet finalnih proizvoda može da se očuva u velikoj meri, jer se proces odvija na niskim temperaturama i bez prisustva vode u tečnom stanju.
U ovom radu ispitivan je uticaj liofilizacije, kao savremenog načina sušenja, na fizičko-hemijske i senzorne karakteristike, kao i antioksidativni kapacitet jagode, maline i kupine. Efekti liofilizacije su utvrđivani analizom promene sadržaja ukupnih šećera i kiselina, suve materije i askorbinske kiseline. Osim toga, ispitivane su i senzorne osobine jagodastog voća ocenjivanjem promene boje, arome, teksture i ukupne prihvatljivosti plodova. Antioksidativni kapacitet je analiziran DPPH metodom, utvrđivanjem sposobnosti neutralizacije slobodnog radikala 1,1-difenil-2-pikrilhidrazila (DPPH), a rezultati su izraženi kao EC50 vrednosti. Rezultati su pokazali da nakon liofilizacije nije došlo do veoma značajne promene fizičko-hemijskih parametara i sadržaja askorbinske kiseline u plodovima jagodastog voća. Osim toga, jagode, maline i kupine su zadržale visok antiokidantni kapacitet nakon liofilizacije. Rezultati senzorne analize pokazuju da su boja i aroma liofilizovanih plodova gotovo nepromenjene u odnosu na sveže jagodasto voće. Može se zaključiti da je liofilizacija vrlo podesna metoda za konzervisanje osetljivih plodova kao što je jagodasto voće.

Effect of freeze-drying on the quality and antioxidant capacity of berry fruits

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Berry fruits are rich sources of phytonutrients and bioactive compounds, which possess high antioxidant capacity and demonstrate beneficial effects on human health. Berry fruits have a brief harvest season and are very sensitive to biochemical and microbial deterioration in a post-harvest period; consequently, they are available in the fresh form in a short period of time. Therefore, berries are candidates for further processing and preservation to enable their accessibility during a year. The method of dehydration may be used in order to extend the shelf life of berry fruit and enable their storage at room temperatures. However, air-drying can leads to a loss of nutritional and sensory properties of food. Freeze-drying is a method of drying based on the sublimation of water from a frozen product. Due to the absence of liquid water and low temperature using in this technique, the quality of the final product may be greatly preserved.
In this study, the effect of freeze-drying on the maintenance of physicochemical and sensory characteristics, as well as antioxidant capacity of strawberry, raspberry and blackberry was investigated. The effects of freeze-drying method on physicochemical properties of berry fruits were expressed in relation to the changes of the amount of total sugars and total acids, dry matter and ascorbic acid content. Also, sensory properties of freeze dried berries were investigated and expressed as the changes in the colour, flavour, firmness and overall acceptance. Antioxidant capacity was measured by DPPH method, radical scavenging activity against the stable free radical 1,1-diphenyl-2-picrylhydrazyl (DPPH) and results were expressed as EC50 values. The results indicated that freeze-drying did not significantly affect the physicochemical parameters and ascorbic acid content of berry fruits. The strawberry, raspberry and blackberry retain high antioxidant capacity after freeze-drying. The results of sensory analysis showed that colour and flavour remained almost unchanged compared to the fresh fruits. Generally, it can be concluded that freeze-drying represent a very suitable method for preserving these delicate berry fruits.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTAINABILITY

OHP38 / FCHP38

Sezonska variranja u sadržaju ukupnih fenola kod šest sorti salate primenom mikrobiološkog đubriva

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Salata (*Lactuca sativa*, L.) je jednogodišnja vrsta, prohladne klime koja pripada familiji *Asteraceae* i grupi lisnatog povrća. Bogata je mineralima, vitaminima, antioksidantima koji su neophodni u ljudskoj ishrani. Prednost salate, kao sirovog povrća, je da sadrži više hranljivih materija u odnosu na drugo termički obrađeno povrće. Salata ima nisku kalorijsku vrednost i preporučuje se u ishrani dijabetičara, ljudi sa poremećenim ritmom spavanja i metabolizma. Proizvođači su zainteresovani za gajenje salate zbog kratkog vegetacionog perioda i mogućnosti gajenja tokom cele godine. Cilj ovog istraživanja bio je da se utvrdi uticaj mikrobiološkog đubriva Em Aktiv (Candor) na sadržaj ukupnih fenola (TPC) kod šest sorti salate. Sorte (′Kiribati′, ′Murai′, ′Aquino′, ′Gaugin′, ′Aleppo′, ′Carmesi′- Rijk Zwaan) su gajene na plodnom zemljištu u plasteniku tokom tri uzastopne sezone (jesen, zima i proleće). Sadržaj ukupnih fenola kretao se u jesen između 175.85-372.73 µg GAE/g FW, u zimu 104.12-522.74 µg GAE/g FW i u proleće 88.88-340.93 µg GAE/g FW. Rezultati ukazuju da su crvene sorte uglavnom pokazale veći sadržaj ukupnih fenola u odnosu na zelene sorte sa izuzetkom jesenjeg ogleda. Među svim sezonama, najveći sadržaj ukupnih fenola određen je u kontroli kod sorte ′Carmesi′ (522.74 µg GAE/g FW) u zimskom ogledu. Uticaj đubriva Em Aktiv na sadržaj ukupnih fenola, kod različitih sorti salate, u određenom opsegu bio je pozitivan u proleće i jesen pa čak i negativan tokom zime. Ovako složen odgovor ukazuje na potrebu za pažljivim odabirom varijeteta salate i đubriva u odnosu na sezonu. Na osnovu dobijenih rezultata može se zaključiti da su crvene sorte salate pokazale veći sadržaj ukupnih fenola i mogu se preporučiti kao izvor bioaktivnih supstanci u zdravoj ishrani.

Seasonal variation of total phenolic content in six lettuce cultivars grown with microbiological fertilizer

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Lettuce (*Lactuca sativa*, L.) is an annual, cool season crop belonging to *Asteraceae* family and to a group of leafy vegetables. It is rich in minerals, vitamins and antioxidative compounds which are essential for human nutrition. The advantage of lettuce, as eaten raw, is that maintains more nutrients than other cooked vegetables. Lettuce is low in calories and it is suggested to diabetics, people with sleep problems and disturbed metabolism. Growers are interested in cultivating lettuce because of their short vegetation period and opportunity to cultivate in all seasons. The purpose of this study was to examine the effect of microbiological fertilizer Em Aktiv (Candor) on the total phenolic content (TPC) in six lettuce cultivars. Cultivars (′Kiribati′, ′Murai′, ′Aquino′, ′Gaugin′, ′Aleppo′, ′Carmesi′- Rijk Zwaan) were grown in the fertile soil in a greenhouse experiment during three successive seasons (autumn, winter and spring). Total phenolic content ranged between 175.85-372.73 µg GAE/g FW in autumn, 104.12-522.74 µg GAE/g FW in winter and 88.88-340.93 µg GAE/g FW in spring. Our results indicated that red cultivars mainly had higher total phenolic content compared to green cultivars with the exception in autumn experiment. Among all seasons, control treatment of cultivar ′Carmesi′ showed the highest total phenolic content (522.74 µg GAE/g FW) in winter. The effect of fertilizer Em Aktiv on TPC in different cultivars was to some extent positive in spring and autumn, but even negative during winter season. Such a complex response indicates the need for careful selection of varieties and fertilizers in relation to the season. To conclude, red cultivars were pointed out with higher total phenolic content and they could be recommended as a great source of bioactive compounds for healthy human diet.

OHP39 / FCHP39

Gljive iz prirode i potopljene kultivacije kao izvori fenolnih jedinjenja

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Gljive predstavljaju bogat izvor fenolnih jedinjenja koja značajno poboljšavaju kvalitet hrane, a produkuju ih plodonosna tela – PT, kao i micelija - M i ekstracelularni medijum, filtrat - F iz potopljene kulture. Cilj rada bio je ispitivanje sadržaja fenolnih jedinjenja u hloroformskim ekstraktima dobijenih iz tri različita izvora (PT, M, F) dve autohtone vrste gljiva *Coprinus comatus* i *Coprinellus truncorum*. Obe micelije bile su kultivisane 14 dana u fermentacionom medijumu na tresilici (26°C, 120 rpm, New Brunswick Scientific, Edison, SAD), nakon čega su pripremljeni ekstrakti od suve liofilizirane biomase sva tri porekla (72 h u hloroformu). Određen je sadržaj ukupnih fenola spektrofotometrijskom metodom i kvantitativno su određena fenolna jedinjenja HPLC-MS/MS metodom. Ekstrakt filtrata *C. comatus* sadržao je najviše ukupnih fenola, što je u skladu sa rezultatima dobijenim HPLC-MS/MS metodom. U ekstraktu F *C. comatus* detektovano je 48 puta više fenolnih jedinjenja nego u ekstraktu M *C. comatus*, odnosno 31 put više nego u ekstraktu PT *C. comatus*. U svim ispitivanim ekstraktima detektovana je *p*-hidroksibenzoeva kiselina u malim koncentracijama od 2,69 do 28,1 µg/g, osim kod ekstrakta F *C. comatus* gde je bila najviše zastupljena (3983 µg/g). Ostale hidroksibenzoeve kiseline (vanilinska, galna i siringiska kiselina - 122 µg/g, 10,1 µg/g, odnosno 85 µg/g), kao i flavon (kvercetin - 27,8 µg/g) bili su detektovani jedino u ekstraktu filtrata *C. comatus*. Rezultati pokazuju da je produkcija fenolnih jedinjenja različita u PT, M i F, što je dokazano i prisustvom flavanola (katehin i epikatehin), kao i izoflavonoida (daidzein i genistein) samo kod ekstrakata potopljene kulture M i F obe vrste. Dalja istraživanja bi trebalo usmeriti ka ispitivanju uticaja pojedinačnih komponenti iz medijuma na produkciju fenolnih jedinjenja, pa samim tim i na kontrolisanu proizvodnju fenola u potopljenim kulturama.

Fungi from nature and submerged cultivation as sources of phenolic compounds

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Fungi represent a rich source of phenolic compounds that improve the quality of food. The fruiting bodies - FB, as well as mycelium - M and extracellular medium, filtrate - F, from submerged culture have an ability to produce phenolic compounds. Our aim was to investigate the content of phenolic compounds in chloroform extracts obtained from three different sources (FB, M and F) of two autochthonous fungal species, *Coprinus comatus* and *Coprinellus truncorum*. Both of the mycelia were cultivated for 14 days in a fermentation medium at shaked at 120 rpm at 26°C (New Brunswick Scientific, Edison, USA), whereupon extracts from dry lyophilized FB, M and F biomass were prepared (72 h in chloroform). The content of total phenols was evaluated spectrophotometrically and by HPLC-MS/MS method for quantitative determination of phenolic compounds. *C. comatus* F extract contained the largest amount of phenols, which is in accordance with HPLC-MS/MS results. *C. comatus* F extract contained 48 times more phenol compounds than *C. comatus* M extract, and 31 times more than *C. comatus* FB extract. Very small amounts of *p*-hydroxybenzoic acid were detected in all investigated types of extracts (in range from 2.7 to 28.1 µg/g) except in *C. comatus* F extract where it was dominant (3983 µg/g). Other hydroxybenzoic acids (vanillic, gallic and syringic acids – 122 µg/g, 10.1 µg/g and 85 µg/g, respectively), and flavonol (quercetin - 27.8 µg/g) were detected only in F extract of *C. comatus*. The results show that the production of phenolic compounds varies in FB, M and F. Supporting this, the presence of flavanol (catechin and epicatechin), as well as isoflavonoids (daidzein and genistein) were detected only in the extracts of submerged culture M and F of both species. Further research should focus on the investigation of the influence of individual components from the medium on production of phenolic compounds and controlled production of phenols in submerged cultures.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP40 / FCHP40

Membransko koncentrisanje ekstrakta biljne prašine žalfije dobijenog ekstrakcijom subkritičnom vodom

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U prezentovanom radu, izvršena je ekstrakcija vodom u subkritičnom stanju (SWE) polifenola iz biljne prašine žalfije (*Salvia officinalis* L.) i koncentrovanje sirovog ekstrakta ultrafiltracijom. SWE je izvršena na prethodno definisanim optimalnim uslovima: temperatura 201,5°C, vreme ekstrakcije 15,8 min i čista voda kao rastvarač. Nakon SWE, sirovi ekstrakt je profiltriran pod vakuumom kroz filter papir, a u sledećem koraku je izvršena mikrofiltracija. Dalje prečišćavanje je izvršeno ultrafiltracijom kroz membrane sa različitim prečnicima pora (*cut-off* 3, 5 i 10 kD) i različitim transmembranskim pritiscima 0,8, 1 i 1,2 bar). Sirovi ekstrakt, kao i frakcije permeata i retentata dobijene pri različitim uslovima ultrafiltracije, su analizirani u pogledu određivanja ukupnih rastvornih jedinjenja (TEC), ukupnih polifenola (TP) i ukupnih flavonoida (TF). Uzorci su takođe analizirani u pogledu antioksidativne aktivnosti primenom DPPH, FRAP i ABTS testova. Na osnovu rezultata zaključeno je da ultrafiltracija pokazuje značajan uticaj na povećanje koncentracije polifenola u permeatu. *Cut-off* molekulskih masa membrane nije pokazao značajan uticaj na promene koncentracija TEC, TP i TF u dobijenim frakcijama. Sa druge strane, zabeleženo je povećanje koncentracije TEC i TF sa povećanjem transmembranskog pritiska, dok nije bilo uticaja na TP.

Membrane concentration of sage herbal dust extract obtained by subcritical water extraction

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In this work, subcritical water extraction (SWE) of polyphenols from sage (*Salvia officinalis* L.) herbal dust was performed and obtained extract was concentrated by ultrafiltration. SWE was performed at previously determined optimized conditions: temperature of 201.5°C, extraction time of 15.8 min and pure water as extraction solvent. Immediately after SWE, crude extract was filtered through filter paper under vacuum, which was followed by microfiltration. Further purification was performed by ultrafiltration through membranes with different molecular weight cut-off (3, 5 and 10 kD) under different transmembrane pressures (0.8, 1 and 1.2 bar). Crude extract, as well as permeate/retentate fractions obtained under different ultrafiltration conditions, were characterized in terms of total soluble compounds (TEC), total phenols content (TP) and total flavonoids content (TF). Furthermore, antioxidant activity of all fractions was determined by DPPH, FRAP and ABTS assays. It could be observed that ultrafiltration had impact on increase of polyphenols content in permeate. Molecular weight cut-off exhibited rather low impact on TEC, TP and TF. On the other hand, concentration of TEC and TF in permeate increased with increase of transmembrane pressure, while there was lack of trend in case of TP.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP41 / FCHP41

Sadržaj dijetnih vlakana u popularnim slanim snek proizvodima sa srpskog tržišta

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Savremenu ishranu karakteriše visok unos energetski bogate hrane, zasićenih i *trans*-masnih kiselina, soli, šećera, a istovremeno je siromašna u sadržaju vitamina, minerala i dijetnih vlakana. Cilj ove studije bio je utvrditi sadržaj ukupnih, rastvornih i nerastvornih dijetnih vlakana u slanim snek proizvodima na tržištu Srbije, često konzumiranih među mladima. Sadržaj je ispitan primenom modifikovanog enzimsko-gravimetrijskog postupka (AOAC 985.29). Sadržaj ukupnih dijetnih vlakana kao i određenih frakcija određen je u 3 glavne kategorije proizvoda: pekarski proizvodi, čips i flips proizvodi i proizvodi na bazi žita, uključujući 107 uzoraka. Prva grupa uključivala je: krekere, perece, slane štapiće, slane ribice, *Bake-rolls*, i *kubete*. Druga grupa uključuje: čips, tortilja čips, flips, flipsi proizvode i *Clipsy*, dok prženo seme kukuruza, kokice, pečena soja, ekspandirani pirinač i pirinčane galete pripadaju trećoj grupi.
Prosečan sadržaj nerastvornih vlakana kretao se od 0.11g/100g kod krekera do 19.57g / 100g u pečenoj soji. U prvoj grupi sadržaj je varirao od 0.11g/100g (krekeri) do 9.64g/100g (slani štapići), u drugoj grupi od 0.22g/100g-11.73g/100g (flips i *Clipsy* uzorci), dok je u trećoj bio u rasponu od 0.59 g/100g (ekspandirani pirinač) do 19,57g/100g u grupi kokica, respektivno. Distribucija frakcija vlakana i njihove količine značajno su se razlikovale u zavisnosti od grupe snek proizvoda. Najbogatiji izvori nerastvornih vlakana bili su: kokice, prženo seme kukuruza i tortilja čips (9 g/100 g-19 g/100 g). Sa druge strane, pečeni slani proizvodi predstavljaju siromašan izvor vlakana. Uzimajući u obzir prosečnu unetu dnevnu porciju ovih proizvoda kao i vrste najčešće konzumiranih slanih snek proizvoda, najbogatiji izvori nerastvornih dijetnih vlakana bili su: kokice, prženo seme kukuruza, tortilja čips, pečena soja. Sa druge strane, ne treba zanemariti činjenicu da neki tipovi slanih proizvoda predstavljaju veoma bogat izvor masti, zasićenih i *trans*-masnih kiselina, kao i soli, na šta treba obratiti posebnu pažnju.

Dietary fiber content in popular salty snack products from Serbian market

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Modern diet has undergone changes and consists mainly of energy-dense food, saturated and *trans*-fatty acids, salt, sugar, but poor in vitamins, minerals and dietary fibers. The aim of present study was to determine the content of dietary fibers in popular salty snacks from Serbian market commonly consumed among youth. Modified enzyme-gravimetric method (AOAC 985.29) have been applied. The content of total dietary fibers as well as certain fiber fractions was determined in 3 main categories of salty snacks: *Baked products, Chips & flips products* and *Cereal-based products* and included 107 samples. The first group included: crackers, pretzels, salty sticks, fish-shaped products, Bake-rolls, kubz. Potato chips, tortilla chips, flips, flips products and clipsy were in second group and fried corn nuts, popcorn, roasted soybean, expanded rise and rice cake represented third group.
The average content of insoluble dietary fibers ranged from 0.11g/100g in crackers to 19.57g/100g in baked soybean. When observed first group the content varied from 0.11g/100g (crackers) to 9.64g/100g (salted sticks), while in second and third group ranged from 0.22g/100g-11.73g/100g (flips and clipsy samples) and 0.59g/100g in expanded rice to 19.57g/100g in the group of popcorn, respectively. Distribution of analyzed dietary fibers and their quantities differed significantly depending on food groups. The highest sources of insoluble dietary fibers have been recorded in popcorn, fried corn nuts and tortilla chips (9g/100g-19g/100g). On the other hand, baked products represented poor source of fibers. When the size
of regular food portions and type of salty snacks were taken into consideration, the best sources of insoluble dietary fibers were: popcorn, fried corn, tortilla chips, baked soybean. Consumers should not ignore the fact that some types of salty snacks represents a rich source of total fats, saturated, *trans*-fatty acids, and salt, which must be seriously taken into account.

OHP42 / FCHP42

Profil osetljivosti gljiva roda *Fusarium* na odbrambeni sekret stonoge *Pachyiulus hungaricus* (Karsch, 1881) (Diplopoda, Julida, Julidae)

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Istraživanja osetljivosti vrsta roda *Fusarium* na prirodne produkte različitog porekla su danas od sve većeg značaja s obzirom na njihovo kosmopolitsko rasprostranjenje, sintezu mikotoksina i značaj za bezbednost hrane u proizvodnji useva. Glavni cilj ovog istraživanja je bio da se *in vitro* proceni antifungalna aktivnost etanolnog (EtOH), metanolnog (MetOH), heksanskog (Hex) i dihlormetanskog (DCM) ekstrakta odbrambenog sekreta *Pachyiulus hungaricus*, u rasponu koncentracija od 0,05 do 0,6 mg mL^{-1}, protiv sedam vrsta roda *Fusarium*, poznatih producenata mikotoksina (trihoteceni, fumonizini i zearalenoni) i uzročnika bolesti i propadanja korena, stabljike i semena biljaka. Najveća aktivnost je zabeležena za EtOH ekstrakt, sa minimalnim inhibitornim koncentracijama (MIC) i minimalnim fungicidnim koncentracijama (MFC) u rasponu od 0,15 do 0,32 mg mL^{-1} i 0,15 do 0,44 mg mL^{-1}. Hex i DCM ekstrakti su pokazali najslabiji antifungalni potencijal, mada jači u poređenju sa antimikotikom Nistatinom (MIC i MFC >0,60 mg mL^{-1}). *Fusarium avenaceum* je bila najosetljivija testirana mikromiceta, dok su *F. graminearum* i *F. sporotrichioides* demonstrirali najveći stepen otpornosti ka testiranim ekstraktima. Veoma jaka antifungalna aktivnost istraživanog sekreta je verovatno posledica prisustva hinona (p-benzohinona i njegovih derivata), kao i kompleksnih interakcija dominantnih hinona sa manje zastupljenim estrima (pentil i heksil estri C14-C18 zasićenih i nezasićenih karboksilnih kiselina).

Ključne reči: antifungalna aktivnost, odbrambeni sekret, *Fusarium*, mikrodiluciona metoda, *Pachyiulus hungaricus*

Antifungal susceptibility profile of *Fusarium* species to defensive secretion of millipede *Pachyiulus hungaricus* (Karsch, 1881) (Diplopoda, Julida, Julidae)

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Research into susceptibility of *Fusarium* species to natural products of various origin is nowadays of considerable interest given their world-wide distribution, mycotoxins synthesis and importance to food safety in crop production. Principal purpose of this study was to *in vitro* assess anti-*Fusarim* properties of ethanol (EtOH), methanol (MetOH), hexane (Hex), and dichloromethane (DCM) extracts of *Pachyiulus hungaricus* defensive secretion, in range of concentrations of from 0.05 to 0.6 mg mL^{-1}, against seven *Fusarium species* known to produce toxic metabolites (trichotecenes, fumonisins and zearalenone) and cause root and stem rots, vascular wilts, fruit root, and infect seed. Strongest activity was observed for EtOH extract, with minimum inhibitory concentrations (MIC) and minimum fungicidal concentrations (MFC) in the range of from 0.15 to 0.32 mg mL^{-1} and 0.15 to 0.44 mg mL^{-1}, respectively. Hex and DCM extracts were shown to possess weakest antifungal potential, though stronger compared to antimycotic Nystatin (MIC and MFC >0.60 mg mL^{-1}, not determined). *Fusarium avenaceum* was the most susceptible fungus, while *F. graminearum* and *F. sporotrichioides* demonstrated the greatest degree of resistance to tested extracts. Such pronounced antifungal property of studied julidan defensive secretion is probably due to the presence of quinones (p-benzoquinone and its derivatives), as well as complex interactions of dominant quinones with less abundant esters (pentyl and hexyl esters of C14-C18 saturated and unsaturated carboxylic acids).

Keywords: antifungal activity, defensive secretion, *Fusarium*, microdilution, *Pachyiulus hungaricus*

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

OHP43 / FCHP43

Sušenje breskve (*P. persica*) u vakuumu: Matematičko modelovanje procesa sušenja

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Breskva (*P. persica*) pripada grupi koštičavog voća i njene sorte su brojne (Lela, Fairtime, Redhaven, San Krest). Veoma je rasprostranjena, dobro se prerađuje u različite proizvode i ima dobre senzorske i nutritivne karakteristike. Breskva ima brojne pogodnosti zahvaljujući visokom sadržaju bioaktivnih komponenata kao što su fenolna jedinjenja, karotenoidi i vitamin C. Ove jedinjenja čine breskve pogodnom sirovinom za prerađivačku industriju.

Konvektivno sušenje toplim vazduhom je najzastupljenija tehnika sušenja u prehrambenoj industriji. Glavni nedostaci ove tehnike jesu prisustvo kiseonika i visoke temperature sušenja, što negativno utiče na kvalitet osušenog proizvoda. Ovi nedostaci uspešno se prevazilaze upotrebom vakuum sušenja gde se sušenje odvija u atmosferi sa niskim sadržajem kiseonika i nižim temperaturama od onih korišćenih pri konvektivnom sušenju. Pronalaženje najboljeg matematičkog modela za aproksimaciju eksperimentalnih podataka dobijenih sušenjem breskve u vakuumu predstavlja značajan doprinos u području ispitivanja kinetike sušenja voća u vakuumu.

Osnovni cilj ovog rada bila je primena matematičkih modela za aproksimaciju eksperimentalnih podataka sušenja breskve i pronalaženje modela koji najbolje opisuje proces sušenja breskve u vakuumu. U okviru istraživanja upotrebljeni su sledeći matematički modeli: Peleg's, Page, Midilli i sar., Logarithmic, Two term, Henderson-Pabis, Modified Henderson-Pabis i Wang & Singh. Za ocenu uspešnosti aproksimacije eksperimentalnih podataka sušenja matematičkim modelima korišćen je koeficijent determinacije R^2. Maksimalna vrednost R^2 uzeta je kao osnovni kriterijum za odabir matematičkog modela koji najbolje opisuje proces vakuum sušenja breskve.

Peach (*P. persica*) vacuum drying: Mathematical modeling of the drying process

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Peach (*P. persica*) belongs to the group of stone fruit and the varieties of this fruit are numerous (Lela, Fairtime, Redhaven, San Krest, etc.). It is very widespread fruit, good for processing in various products and it possess good sensory and nutritional properties. Peach has many benefits due to the high content of bioactive components such as phenolic compounds, carotenoids and vitamin C. These compounds make peaches suitable for the processing industry.

Convective drying with hot air is the most commonly used drying technique in the food industry. The main disadvantages of this technique are the presence of oxygen and high drying temperatures, which negatively affects the quality of the dried product. These deficiencies could be successfully overcome by using vacuum drying, where drying process takes place in an atmosphere with low content of oxygen and with lower temperatures compared to those used in convective drying. Finding the best mathematical model for the approximation of experimental data obtained by peach vacuum drying presents a significant contribution in the field of investigation of the kinetics of fruit vacuum drying.

The main goal of this research was the application of mathematical models for the approximation of experimental data and also finding a model which describes the best peach vacuum drying. The following mathematical models were used in the research: Peleg's, Page, Midilli et al., Logarithmic, Two Term, Henderson-Pabis, Modified Henderson-Pabis and Wang & Singh. In order to determine the success of the approximation of experimental drying data, the coefficient of determination R^2 was used. The maximum value of R^2 was taken as the main criterion for determination of the mathematical model which describes the best peach vacuum drying.

Različiti pristupi multivarijantne analize prilikom GC×GC-MS karakterizacije medljikovaca

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Sveobuhvatna dvodimenzionalna gasna hromatografija sa masenim spektrometrom (GC×GC-MS) u kombinaciji sa softverom za obradu slika i metodama prepoznavanja obrazaca primenjena je za karakterizaciju i klasifikaciju medljikovaca kako bi se utvrdilo postojanje specifičnih obrazaca među medljikovcima različitog botaničkog porekla. Područja hromatografskih tačaka na konturnim pločama, nakon poravnavanja i normiranja ciljane zone, korišćena su kao ulazni podaci za statističku procenu. Pored toga, identifikacija 200 jedinjenja bazirana je na dekonvolucionim masenim spektrima i upoređivanju linearnih retencionih indeksa sa podacima iz literature. Identifikovana jedinjenja uključuju estre, alkohole, aldehide, ketone, kiseline, acetale, furane i laktone, sumporna jedinjenja, azotna jedinjenja, terpene, ugljovodonike, isparljive fenole i pirane. Mnoga od ovih jedinjenja su zajednička za svih pet botaničkih vrsta, mada su uočene i isparljive komponente karakteristične za svaku od ispitivanih vrsta. Ovi podaci, predstavljeni kao kategorijske varijable, takođe su korišćeni za klasifikaciju analiziranih uzoraka koristeći nelinearnu analizu glavnih komponenata.

Ključne reči: Medljikovac, isparljiva organska jedinjenja, dvodimenzionalna gasna hromatografija sa masenim spektrometrom, multivarijantna analiza

Different approaches for multivariate data analysis in GC×GC-MS fingerprinting of honeydew honey

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Comprehensive two-dimensional gas chromatography-mass spectrometry (GC×GC-MS) combined with software for image processing and pattern recognition methods was applied for fingerprinting and classification of honeydew honey samples in order to evaluate the existence of data patterns among honeys of different botanical origin. Areas of the chromatographic spots in contour plots, after target peak alignment and normalization, were used as input data for statistical evaluation. Additionally, tentative identification of 200 compounds was based on deconvoluted mass spectra and comparison of linear retention indices with literature data. Identified compounds included esters, alcohols, aldehydes, ketones, acids, acetals, furans and lactones, sulphur compounds, nitrogen compounds, terpenes, hydrocarbons, volatile phenols and pyrans. Many of the compounds were common to all five botanical species, although volatile components unique to specific samples were also observed. These data, presented as categorical variables, were also used for classification of analysed samples using nonlinear principal component analysis.

Key words: Honeydew honey, volatile organic compounds, comprehensive twodimensional gas chromatography with mass spectrometry, multivariate data analysis

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OHP45 / FCHP45

ANTIBAKTERIJSKI EFEKAT VINSKIH MARINADA SA ETARSKIM ULJIMA *Juniperus communis* I *Satureja montana* NA KONTAMINENTE JUNEĆEG MESA

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Proces mariniranja se obično koristi za unapređenje senzornih svojstava mesa, ali doprinosi i kontroli mikrobiološke kontaminacije. Vina se često koriste za marinaciju, a etarska ulja (EO) se u marinade mogu dodavati i kao arome i kao prirodni konzervansi. Cilj ovog rada je ispitivanje antibakterijskog efekta različitih marinada od crnog vina na junećem mesu. Testirane su osnovna vinska marinada (BM), marinada sa dodatkom EO *Juniperus communis* (BM+J), EO *Satureja montana* (BM+S) i kombinacije oba ulja (BM+JS). Ispitan je antibakterijski efekat prema patogenu hrane *Listeria monocytogenes* inokulisanom na meso, kao i prema prisutnim mikrobiološkim kontaminentima iz grupa aerobnih heterotrofnih mezofilnih bakterija (AHMB), Enterobacteriaceae i bakterija mlečne kiseline (LAB).
Rezultati testa vremenski zavisne inhibicije rasta ukazuju da su vrednosti log CFU/g za sve praćene grupe smanjene primenom svake od marinada, a u odnosu na negativnu kontrolu (0,85% kuhinjska so). Izrazit je efekat BM marinade, koja je redukovala brojnost bakterija za oko 2-3 log CFU/g. Dodatak bilo kog pojedinačnog ulja ili njihove kombinacije dodatno je smanjilo brojnost za oko 1-2,5 log CFU/g u odnosu na BM. Interesantno je da je jasno pojačavanje antibakterijskog efekta u slučaju BM+JS, a u poređenju sa BM+J i BM+S, uočeno samo u slučaju AHMB. Rezultat senzorne analize ukazuje na prihvatljivost ukusa i mirisa marinada sa svim testiranim koncentracijama ulja *J. communis*. Sa druge strane, dodatak ulja *S. montana*, kao i kombinacije oba ulja, bili su senzorno prihvatljivi samo kada su test supstance bile primenjene u nižim koncentracijama.
Ovaj rad je potvrdio antibakterijski efekat marinada od crnog vina i ukazao na mogućnost korišćenja etarskih ulja *J. communis* i *S. montana* u cilju povećanja održivosti junećeg mesa. Činjenica da ona mogu inhibirati rast *L. monocytogenes* i bakterija kvarenja hrane stimuliše dalja istraživanja.

ANTIBACTERIAL ACTIVITY OF RED-WINE MARINADES CONTAINING *Juniperus communis* AND *Satureja montana* ESSENTIAL OILS AGAINST FOOD CONTAMINANTS IN BEEF

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Marinating process is commonly used to improve the sensory properties of meat, but it also contributes to control of microbial contamination. Wines are frequently used for marination, while essential oils (EOs) could be added both as flavoring agents and natural preservatives. The aim of this work was to monitor the antibacterial effect on beef soaked in red wine-base marinades without EO (BM), or containing *J. communis* EO (BM+J), *S. montana* EO (BM+S) or their combinations (BM+JS). The antibacterial activity was evaluated against food borne pathogen *Listeria monocytogenes* inoculated on meat, and against naturally occuring meat spoilage bacteria: aerobic heterotrophic mesophyll bacteria (AHMB), Enterobacteriaceae and lactic acid bacteria (LAB). In addition, sensory properties of marinated meat was determined.
Results of time kill assay revealed that comparing to saline (0.85% table salt), the counts of log CFU/g for all monitored groups dropped in all marinades. The remarkable effect was achieved with the BM which reduced the counts of all tested groups comparing to saline, for approximately 2-3 log CFU/g. The addition of any single oil or their combination enhanced the antibacterial effect of marinade (additional drop of log CFU/g for 1-2.5 units, comparing to BM). Interestingly, the clear enhance of antibacterial effect with oil mixture, comparing to any single oil, was obtained only in the case of AHMB.
Results of sensory analysis indicated that addition of any tested concentration of *J. communis* EO in marinade was acceptable in terms of taste and odor, while addition of *S. montana* EO, or oil combination, was acceptable only at lower tested concentrations.
This work confirmed the antibacterial effect of red wine marinades and elucidated the potential use of *S. montana* and *J. communis* essential oils in beef preservation. Since they could provide a safety barrier against *L. monocytogenes* and food spoilage bacteria, further research is encouraged.

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OHP46 / FCHP46

Antimikrobna svojstva ekstrakata *Rubus discolor* i mogućnost njihove primene u konzerviranju hrane

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Rubus discolor Weihe & Nees (Rosaceae) je žbunasta biljka rasprostranjena širom Evrope, čija je upotreba u ishrani i narodnoj medicini odavno poznata. U ovom radu su ispitivana antimikrobna svojstva vodenih i etanolnih ekstrakata listova i plodova navedene vrste. Procenjena je sposobnost etanolnog ekstrakta ploda kupine da zaustavi rast patogene bakterije *Listeria monocytogenes* NCTC7973 nakon inkorporacije u jogurt kao i organoleptička svojstva nastalog proizvoda. Antifungalna aktivnost na *Aspergillus fumigatus* (humani izolat), *A. versicolor* ATCC11730, *A. ochraceus* ATCC12066, *A. niger* ATCC6275, *Trichoderma viride* IAM5061, *Penicillium funiculosum* ATCC36839, *P. ochrochloron* ATCC9112 i *P. verrucosum* var. *cyclopium* (izolat hrane) je određena mikrodilucionom metodom. MIC vrednosti su bile između 1,11 i 22,52 mg/ml, dok su se MFC vrednosti kretale od 2,21 do 45,04 mg/ml. Najosetljivije na dejstvo ekstrakata su bile *A. versicolor*, *A. ochraceus* i *A. niger*. Posebnu efikasnost pokazao je vodeni ekstrakt lista kupine. Antibakterijsko dejstvo ekstrakata je testirano na sledeće bakterijske sojeve: *Bacillus cereus* (klinički izolat), *Listeria monocytogenes* NCTC7973, *Enterobacter cloacae* ATCC35030 I *Staphylococcus aureus* ATCC6538. MIC vrednosti su bile u opsegu od 0,18 do 22,73 mg/ml, a MBC vrednosti od 0,36 do 45,45 mg/ml. Ekstrakti su bili najdelotvorniji protiv *B. cereus*. Etanolni ekstrakt ploda kupine *R. discolor* inkorporiran u jogurt, uspešno je zaustavio rast *L. monocytogenes*. Grupa ispitanika je visoko ocenila organoleptičke karakteristike krajnjeg proizvoda. Dobijeni rezultati ukazuju da ekstrakti plodova i listova poseduju značajnu efikasnost u borbi protiv patogenih mikroorganizama koji su uobičajeni uzročnici kvarenja namirnica. Stoga se ekstrakti *R. discolor* mogu posmatrati i kao potencijalni izvor prirodnih konzervanasa.

Antimicrobial properties of *Rubus discolor* extracts and their potential use in food preservation

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Rubus discolor Weihe & Nees (Rosaceae) is shrubby plant, widely distributed in Europe. The usage of its leaves and fruits as food and folk medicine is known since ancient times. This study was designed to evaluate antimicrobial properties of aqueous and ethanol leaf and fruit extracts of *R. discolor*. The ability of ethanolic fruit extract to inhibit growth of *Listeria monocytogenes* NCTC7973 in yoghurt and its sensorial characteristics were also estimated. Antifungal activity against *Aspergillus fumigatus* (human isolate), *A. versicolor* ATCC11730, *A. ochraceus* ATCC12066, *A. niger* ATCC6275, *Trichoderma viride* IAM5061, *Penicillium funiculosum* ATCC36839, *P. ochrochloron* ATCC9112 and *P. verrucosum* var. *cyclopium* (food isolate) was determined by microdilution method. The MIC values were among 1.11 and 22.52 mg/ml, while MFC were from 2.21 to 45.04 mg/ml. The most affected were *A. versicolor*, *A. ochraceus* and *A. niger*, particularly by aqueous leaf extract.
Antibacterial activity was tested against following bacterial strains: *Bacillus cereus* (clinical isolate), *Listeria monocytogenes* NCTC7973, *Enterobacter cloacae* ATCC35030 and *Staphylococcus aureus* ATCC6538. MIC values were from 0.18 to 22.73 mg/ml, while MBC values ranged from 0.36 to 45.45 mg/ml. *B. cereus* was the most sensitive among used bacterial strains. Additionally, ethanolic fruit extract inhibited growth of *L. monocytogenes* after incorporation in cow yoghurt and the panel lists gave high marks to the novel product regarding its sensorial properties. The obtained results indicate that *R. discolor* leaf and fruit extracts were significantly active against some commonly found food pathogens and, therefore, might be considered as natural sources for food preservation.

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OHP47 / FCHP47

Aromatični profil i senzorne karakteristike likera od meda

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Likeri su atraktivna alkoholna pića sa prijatnom slatkom aromom koja potiče od proizvodne sirovine. Med se tradicionalno koristi kao zaslađivač u proizvodnji likera. Aromatski profil meda je veoma kompleksan i obuhvata više od 129 jedinjenja. Ekstrakti bilja se često koriste da bi obogatili aromu likera od meda. Rastvorljiva jedinjenja meda i biljnih ekstrakata čine aromatski kompleks likera od meda, koji je suštinski parametar njihovog senzornog kvaliteta.

U ovom radu ispitivan je aromatiski profil likera od meda i identifikovana su glavna jedinjenja koja su određivala njihove senzorne karakteristike. Liker od meda se proizvodi dodatkom biljnog ekstrakta, proizvedenog ekstrakcijom 44 različitih biljnih vrsta (39 aromatičnih i gorkih biljaka, 4 voćnih plodova i kore hrasta). Aromatični profil je analiziran pomoću GC-MS/FID. Senzorne karakteristike likera utvrđene su korišćenjem modela pozitivnog rangiranja. Ocenjivani su zajednički parametri kvaliteta: bistrina, boja, tipičnost, miris i ukus. Maksimalni rezultat senozorne ocene likera od meda može biti 20 bodova.

Rezultati GC-MS/FID su pokazali da je isparljiva frakcija sadržala 38 jedinjenja sa relativno visokom koncentracijom izoamil alkohola (26,71 mg / L) i etilacetata (13,47 mg / L). Ukupan senzorni kvalitet uzorka ocenjen sa 18,2 bodova, što je vrlo dobar rezultat. Dobijeni rezultati pokazuju da liker od meda obogaćen ekstraktom bilja može biti vrlo interesantan proizvod na svetskim tržištima.

Aromatic profile and sensory characteristics of honey liquer

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Liqueurs are attractive alcoholic beverages with pleasant sweet aroma which derived from the raw material of product. The honey is traditionally used as a sweetener in liqueur production. Additionally, the aromatic profile of honey is complex and consists of more than 129 compounds. The herbal extracts are also widely used as an additional source of compounds, which improve the aroma honey liqueur. The extralabile compounds of honey and herbal extract enriched the aromatic complex of honey liqueurs, which is an essential parameter of their sensory quality.

In this study the aromatic profile of honey liqueur was investigated and the main compounds which influenced on its sensory characteristics were identified. The honey liqueur is produced by addition of herbal extract, which is produced of 44 different plant species (39 herbs -aromatic and bitter, 4 dried fruits and 1 wood's bark). Aromatic profile was analyzed by GC-MS/FID. Sensory characteristics of the liqueurs were determined using model of positive ranking. The common quality parameters were evaluated: clearness, color, distinction, odor and taste. In this evaluation a honey liqueur sample may have a maximal score of 20 points.

The results of GC-MS/FID analyses of honey liqueur showed that the volatile fraction of honey liqueurs contained 38 compounds, and It contained relatively high concentration of isoamyl alcohol (26.71 mg/L) and etylacetat (13.47 mg/L). The results of sensorial evaluation show that total sensory quality of sample was 18.2, which is a very good score. The obtained results showed that honey liqueur enriched with the extract of herbs can be very interesting products in world markets.

OHP48 / FCHP48

Upotreba briofita u unapređenju kvaliteta i proizvodnje hrane

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Briofite su druga po veličini grupa biljaka u kopnenim ekosistemima, nakon cvetnica. One nastanjuju sve tipove staništa, osim mora. Iako briofite formiraju veliku biomasu u pojedinim ekosistemima, kao što su tropske kišne šume ili tundre, one se ne koriste ekstenzivno u biotehnološkim industrijskim procesima. Poslednjih godina, ova grupa biljaka je počela da se koristi u istraživanjima koja imaju primenu u industriji, za komercijalnu proizvodnju. Međutim, samo je nekoliko vrsta briofita testirano i korišćeno u ovom tipu istraživanja. U ovom radu predstavljamo istraživanja u kojima su korišćeni vodeni ekstrakti briofita u kontroli i proizvodnji hrane, kao i u poboljšanju njenog kvaliteta. Određen broj vrsta briofita poreklom iz Srbije je korišćen u istraživanju efekata antifungalne aktivnosti u cilju usporavanja propadanja voća (jagode, breskve ili kajsije). Briofite takođe imaju i efekat repelenata u odnosu na voćne mušice i puževe. Velika produkcija briofita se može postići upotrebom brioreaktora, pri čemu je moguće da se izoluje dovoljna količina odgovarajućih bio-degradibilnih i neškodljivih jedinjenja iz ove grupe biljaka. Tako dobijena jedinjenja mogu da se koriste u različitim postupcima u kojima se produžava trajanje plodova, kao repelenti protiv raznih štetočina tokom proizvodnje i skladištenja povrća i voća, kao i u nekim drugim biotehnološkim pristupima tokom kojih se povećava sigurnost, kvalitet i produkcija hrane.

The use of bryophytes to improve food quality and production

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Bryophytes are the second biggest group in terrestial ecosystems, just after flowering plants. They inhabit all habitat types except seas. Though bryophytes reach significant biomass in some of the ecosystems like tropical rain forest or tundras, they have not been used extensively in biotechnological processes. Lately, bryophytes started to appear in research related to industry production or commercial products. However, just a few species were tested and widely applied in everyday lives. Here we present the investigation of various bryophyte species aquaous extracts in food safety, food production and quality improvement. A dozen bryophyte species from Serbia were tested as antifungal human non-harmful natural extracts for fast decaying fruits, like e.g. strawberries, peaches or apricots. They also express some repellent activity to small fruit flies. Additionally, some extracts express anti-feeding effects to different snail species tested during growth and storage of lettuce. Huge production of bryophyte biomass can be achieved by bryo-reactor techniques. The aim is to reach enough quantity of these bio-degradable and non harmful compounds from briophytes. They can be used in various procedures for fruit-life extension, as pest-repellent during production and storage of vegetables and fruits, as well as in other biotechnical approach with aim to improve food safety, food quality and production.

OHP49 / FCHP49

Sastav i sadržaj antocijanina u zrnu plavog i purpurnog kukuruza. Kukuruz kao „SuperHrana“

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S obzirom na njihov snažan antioksidativni kapacitet, antocijanini su prepoznati kao novi agensi u prevenciji bolesti povezanih sa slobodnim radikalima, kao što su kancer, neurološka oboljenja, kardiovaskularne bolesti, upale, dijabetes, bakterijske infekcije i starenje. U hrani, glavni izvori antocijanina su bobičavo voće, kao i neko povrće. Međutim, žitarice, poput plavog i purpurnog kukuruza, su značajni izvori antocijanina. Prerada ovih žitarica može generisati veliku količinu antocijaninima bogatih nusproizvoda s obzirom da se ova pigmentna jedinjenja nalaze u spoljnim slojevima zrna koji se mogu razdvojiti u procesu mlevenja.

Korišćeni genotipovi kukuruza dobijeni su iz banke gena Instituta za kukuruz „Zemun Polje“. Zrna kukuruza kokičara plavog aleurona sakupljena su u okolini Kragujevca (centralni deo Srbije), dok je tamno purpurni kukuruz standardnog zrna kupljen od lokalnih poljoprivrednika iz okoline Santiaga (Čile). Purpurna boja zrna potiče od kombinacije antocijanskih gena za plavi perikarp i plavi aleuron. Sadržaj ukupnih antocijanina u zrnu tamno purpurnog kukuruza iznosio je čak 4989 mg CGE/kg. Sadržaj u ovom kukuruzu bio je viši nego u aroniji (4341 mg CGE / kg - podaci iz literature) i znatno viši nego u ostalom bobičavom voću, dok je sadržaj u plavom kokičaru od 900 mg CGE/kg bio znatno viši od onog u jagodi i malini. Deset antocijanina identifikovano je u zrnu plavog kukuruza, od kojih su dva izomeri cijanidin-3-(malonilglukozida) i tri cijanidin-3-(dimalonil-β-glukozida). U tamno purpurnom kukuruzu identifikovano je sedam antocijanina. Cijanidinski derivati, u ukupnom sadržaju od 1460.3 i 465.2 μg/g, bili su dominantni antocijanini u tamno purpurnom i plavom kukuruzu. Od ukupnog sadržaja, acilovani derivati cijanidina činili su 98 i 29%. Iako su acilovani derivati manje termički i pH stabilni, njihova konverzija u glikozide preporučuje upotrebu sirovina bogatih acilovanim antocijaninima, kao što su žitarice, u prehrambenoj industriji.

Composition and content of anthocyanins in blue and purple maize grain. Maize as „SuperFood“

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Given to their high antioxidant capacity, anthocyanins have been recognized as novel agents in the prevention of free radical-related diseases such as cancer, neurological diseases, cardiovascular diseases, inflammation, diabetes, bacterial infections and aging. In food, the main sources of anthocyanins are berries and some vegetables. However, colored grains, such as blue and purple maize, are significant source of anthocyanins. Actually, cereal processing can generate a large amount of anthocyanins-rich by-products at low cost given that anthocyanin pigments are located in the outer layers of the grain.

Maize genotypes was obtained from the Maize Research Institute gene bank. The grains of blue aleurone popping maize were collected in the vicinity of Kragujevac (Central part of Serbia), while deep purple standard-grain maize was bought from local farmers in the vicinity of Santiago (Chile). The purple color of maize grain comes from a combination of anthocyanin genes for blue pericarp and blue aleurone. The content of total anthocyanins in the grains of deep purple maize was as high as 4989 mg CGE/kg. It was higher than that in chokeberry (4341 mg CGE/kg - literature data) and significantly higher than in other berry fruits. The content of 900 mg CGE/kg in blue maize was significantly higher than that in strawberry and raspberry. Ten anthocyanins were identified in blue popping maize, of which two are isomers of cyanidin-3-(malonylglucoside) and three of cyanidin-3-(dimalonyl-β-glucoside). In the deep purple maize seven anthocyanins have been identified. Cyanidin derivatives, in total contents of 1460.3 and 465.2 μg/g, were predominant anthocyanins in deep purple and blue maize, respectively. Of the total content, acylated forms of cyanidin derivatives accounted 98 and 29%. Although the acylated derivatives are less thermal and pH stable, their conversion to glycosides recommends the use of acylated anthocyanins-rich raw materials, such as cereals, in the food industry.

OHP50 / FCHP50

α-Dikarboniln jedinjenja kao prekursori krajnjih proizvoda glikacije u keksu na bazi žitarica

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Veliki broj reaktivnih karbonilnih jedinjenja, koja su povezana sa korisnim i štetnim fizičko-hemijskim osobinama, identifikovana su u hrani. Jedan od glavnih izvora α-dikarbonilnih jedinjenja u ishrani su, na tržištu široko zastupljeni, različiti keksovi. α-Dikarbonilna jedinjenja odgovorna su za glikaciju više biomolekula *in vivo*, a formiraju se tokom termičkog tretmana u procesu Majarove reakcije, karamelizacije i lipidne oksidacije. Iako su povezani sa mnogim poremećajima metabolizma kao što su dijabetes, gojaznost, kardiovaskularne, neurološke i bubrežne bolesti, α-dikarbonilna jedinjenja igraju važnu ulogu u razvoju ukusa i braon boje, što su poželjne posledice termičke obrade određene hrane.
Ova istraživanja sprovedena su kako bi se ocenilo formiranje α-dikarbonilnih jedinjenja (3-deoksiglukozona, 1-deoksiglukozona, glukozona, glioksala, metilglioksala i diacetila) u keksu na bazi žitarica pečenom na 200°C u trajanju od 7 i 10 minuta. Stepen promena sadržaja šećera u keksu kao posledica povišene temperature takođe je praćen. Korišćena brašna, belo pšenično brašno, brašno od žutog kukuruza i celog zrna golozrnog ječma, međusobno su se razlikovala po sadržaju ukupnih fenolnih jedinjenja. Rezultati pokazuju da je koncentracija 3-deoksiglukozona, 1-deoksiglukozona i glukozona (33,8 i 47,8 mg/kg, 2,5 i 3,9 mg/kg, odnosno 0,84 i 0,58 mg/kg na 7 i 10 min), bila najviša u keksu pripremljenom od brašna golozrnog ječma bogatog fenolnim jedinjenjima, između ostalog proantocijanidinima, i takođe povezana sa visokim stepenom hidrolize saharoze u ovim uzorcima. Sa druge strane, zabeležena je negativna korelacija između ukupnih fenolnih jedinjenja i sadržaja glioksala, metilgloksala i diacetila. Posle 10 minuta pečenja, sadržaj metilgloksala u keksu pripremljenom od kukuruzog i ječmenog brašna bio je oko 2 puta niži od sadržaja u pšeničnom keksu. Smanjen sadržaja pripisuje se sposobnosti fenolnih jedinjenja za hvatanje i uklanjanje α-dikarbonila.

α-Dicarbonyl compounds as precursors of advanced glycation endproducts in cereal cookies

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Great number of reactive carbonyl species (RCS), that are associated with both beneficial and harmful physicochemical properties, have been identified in various foods and model systems. One of the major sources of α-dicarbonyl compounds in diet are cookies. These compounds are responsible for glycation of several biomolecules *in vivo*. Maillard reaction, caramelization and lipid oxidation are responsible for the formation of α-dicarbonyl compounds in foods during thermal processing. Although they are associated with many metabolic disorders such as diabetes, obesity, cardiovascular, neurological and renal diseases, α-dicarbonyl compounds play an important role on flavor and browning development, which are desirable consequences of thermal processing of certain foods.
This study was performed to evaluate the formation of α-dicarbonyl compounds (3-deoxyglucosone, 1-deoxyglucosone, glucosone, glyoxal, methylglyoxal, and diacetyl) in cereal cookies baked at 200ºC for 7 and 10 min. The degree of sugars content changes in the cookies as a result of the elevated temperature is also monitored. Flour of wheat, yellow maize and wholegrain hull-less barley with different content of phenolic compounds were used. The results indicated that the contents of 3-deoxyglucosone, 1-deoxyglucosone and glucosone (33.8 and 47.8 mg/kg, 2.5 and 3.9 mg/kg, 0.84 and 0.58 mg/kg for 7 and 10 min, respectively) were the highest in cookies prepared from hull-less barley flour rich in phenolic compounds, between others in proanthocyanidins. The highest content of these compounds was also related with the highest sucrose hydrolysis in the samples. On the other hand, a negative correlation was observed between total phenolic compounds and glyoxal, methylglyoxal and diacetyl content after baking. After 10 minutes of baking, content of methylglyoxal in maize and barley cookies was about 2 times lower than that in wheat cookies. α-Dicarbonyl compound trapping ability of phenolic compounds was attributed to this reduction during baking of cookies.

OHP51 / FCHP51

TERMALNA KARAKTERIZACIJA OSUŠENOG TROPA JABUKE

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Održiva poljoprivredna proizvodnja, jedna od ključnih izazova današnjice, podrazumeva iskorišćenje nusproizvoda. Industrija prerade jabuke stvara velike količine otpada. Obrada i upotreba osušenog tropa jabuke u prehrambenoj industriji obično podrazumeva termičku obradu. Poznavanje termalnih svojstava je od značaja za očuvanje kvaliteta proizvoda tokom skladištenja. Cilj ovog rada je termalna karakterizacija osušenog tropa od organski gajenih jabuka sorte crveni delišes i komercijalnog uzorka pod nazivom Apple egg (Anti-grain, SAD). Diferencijalni skenirajući kalorimetar (DSC) je korišćen za određivanje termalnih karakteristika. Temperatura staklastog prelaza (Tg) za organski trop jabuke od sorte crveni delišes je bila 30.3 °C, dok je za komercijalni uzorak bila 21.4 °C. Iz dobijenih rezultata može se zaključiti da bolje termalne karakteristike u odnosu na Tg vrednost ima trop od organski gajene jabuke sorte crveni delišes.

THERMAL CHARACTERIZATION OF DRIED APPLE POMACE

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Sustainable agricultural production, one of the key challenges of today, includes the utilization of by-products. The apple processing industry generates enormous amounts of waste. The processing and use of dried apple pomace in the food industry usually involves thermal processing. Knowledge of thermal properties is essential to preserve the desired product quality during storage. The aim of this study was to investigate thermal characteristics of dried apple pomace from organic cultivated apples of Red Delicious variety and commercial sample named Apple egg (Anti-grain, USA). A differential scanning calorimeter (DSC) was used to perform DSC experiments. The glass transition temperature (Tg) of organic apple pomace from Red Delicious variety and commercial sample was 30.3 and 21.4 °C, respectively. According to measured Tg values better thermal behavior can be ascribed to organic apple pomace from Red Delicious variety.

OHP52 / FCHP52

ODREĐIVANjE POLIFENOLNOG I ŠEĆERNOG PROFILA U UZORKU TROPA OD ORGANSKI GAJENIH JABUKA

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U industriji prerade jabuke nastaje velika količina tropa koji se sastoji od kore, koštice, peteljke i pulpe. S obzirom na sadržaj nutritijenata, trop od jabuke pruža mogućnost kreiranja prehrambenih proizvoda iz kategorije funkcionalne hrane. Nažalost, trop se u Srbiji koristi kao hrana za životinje, a najčešće se baca.
Cilj ovog rada je određivanje polifenolnog i šećernog profila tropa od organski gajenih jabuke sorte crveni delišes. Sadržaj šećera određen je primenom visokoefikasne tečne hromatografije sa anjonskom jonskom izmenom i elektrohemijskom detekcijom, dok je sadržaj polifenola određen pomoću UHPLC-DAD MS/MS tehnike.
Trop jabuke sastoji se uglavnom od polisaharida i polifenola koji su odgovorni za antioksidativnu aktivnost.
U šećernom profilu dominiraju glukoza, fruktoza, saharoza i sorbitol a u polifenolnom floretin, florizin i kvercetin.

DETERMINATION OF SUGAR AND POLYPHENOLS PROFILE IN APPLE POMACE SAMPLE FROM ORGANIC CULTIVATED APPLES

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The apple processing industry generates enormous amounts of apple pomace which mainly consists of peel, seed kernel, calyx, stem and soft tissue. Having in mind its high nutritional value, this by-product possesses huge potential to be converted into functional food. However, in Serbia apple pomace is still used only as animal feed or thrown away.
The framework of this study is determination of sugar and polyphenolic profile of apple pomace from organic cultivated apples of Red Delicious varieties. The sugar profile was detemined by the means of high performance anion exchange chromatography with pulse amperometric detection, whereas the polyphenols were determined by the UHPLC–DAD MS/MS technique
The apple pomace consists mainly of cell wall polysacharides and polyphenols which are responsable for antioxidative activity.
The main sugars constituents are glucose, fructose, sucrose and sorbitol, whereas phloretine, phlorizine and quercetine are the most abundant polyphenols.

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ODRŽIVOST HRANE / FOOD CHAIN SUSTANIBILITY

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Eksperimentalna analiza ultrafiltracije model rastvora voćnog soka u prisustvu promotora turbulencije

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Ultrafiltracija (UF) model rastvora voćnog soka vršena je korišćenjem neorganskih Carbosep M9, M8 i M7 membrana sa MWCO od 300, 50 i 30 kDa, respektivno. UF je izvođena u kontinualnom režimu unakrsnog protoka. Fluks permeata je meren pri različitim radnim uslovima, što podrazumeva različite transmembranske pritiske (TMP) i različite brzine strujanja napojnog rastvora. U eksperimentima je korišćen promotor turbulencije unutar cevne membrane. Ubacivanjem promotora turbulencije može se postići veći maseni protok permeata. Istovremeno, povećava se stacionarni fluks permeata, kao i mogućnost njegovog povećanja pri strožijim radnim uslovima. Najveći porast masenog protoka i fluksa permeata, upotrebom promotora turbulencije i variranjem TMP, zabeleženi su na nižim TMP od 1 do 1,5 bara kod sve tri membrane. Ubacivanjem promotora turbulencije, fluks permeatea ne zavisi od fluksa retentata, jer se u ovom slučaju javlja intenzivna turbulencija i vrednost polarizacionog otpora je vrlo slična vrednosti hidrauličkog otpora membrane. Shodno tome, vrednosti ukupnih otpora su veoma male, pa se može zaključiti da je korišćenje promotora turbulencije veoma efikasan način smanjenja polarizacionog otpora u procesu ultrafiltracije soka.

An experimental analysis of ultrafiltration of synthetic fruit juice in presence of turbulence promoters

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Ultrafiltration (UF) of synthetic fruit juice was carried out using inorganic Carbosep M9, M8 and M7 membranes with MWCO of 300, 50 and 30 kDa, respectively. UF is performed in continuous cross – flow mode. The permeate fluxes are measured under different operating conditions, regarding transmembrane pressure (TMP) and feed flow rate. The experiments were conducted using turbulence promoter inside of tube membrane. By inserting turbulence promoter a higher mass flow of permeate can be achieved. At the same time, stationary permeate flux increases as well as the possibility of its increase by creating more demanding working conditions. The highest increase in mass flow rate and permeate flux, by using turbulence promoter, and variating the TMP, were recorded at lower TMP from 1 to 1,5 bars with all three membranes. If a turbulence promoter is inserted, permeate flux does not depend on retentate flux because in this case, an intense turbulence is observed with polarising resistance value very similar to the value of hydraulic membrane resistance. Consequently the overall resistance records at very low levels so it can be concluded that the use of turbulence promoters is a very efficient way of decreasing polarisation resistance in processes of juice ultrafiltration.