Hranom do zdravlja : knjiga sažetaka s 11. međunarodnog znanstveno-stručnog skupa

11 hranom do zdravlja with food to health

Knjiga sažetaka s 11. međunarodnog znanstveno-stručnog skupa

Book of Abstracts of the 11th International Scientific and Professional Conference

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BOOK OF ABSTRACTS / KNJIGA SAŽETAKA

11th International Scientific and Professional Conference

WITH FOOD TO HEALTH

October 18th and 19th 2018, Split, Croatia

11. međunarodni znanstveno-stručni skup

HRANOM DO ZDRAVLJA

18. i 19. listopada 2018., Split, Hrvatska

Split, Osijek and / i Tuzla, 2018.

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Table of Contents / Sadržaj

SCIENTIFIC PROGRAMME /
PROGRAM SKUPA

SCIENTIFIC PROGRAMME / PROGRAM SKUPA

Thursday, October 18th 2018 / Četvrtak, 18. listopada 2018.

09:00-10:00	***Registration of participants*** **Prijava i registracija sudionika**
10:00-10:30	**Conference opening Ceremony** **Otvorenje Skupa**
10:35-11:00	***Coffee Break, Poster Session*** **Pauza za kavu, razgledavanje postera**

***Plenary lectures* / Plenarna predavanja**
***Moderators* / Moderatori:**
Tea Bilušić, Daniela Čačić Kenjerić

11:00-11:25	**FOOD-BASED INTERVENTION TO IMPROVE THE NUTRITIONAL AND HEALTH STATUS IN GERIATRIC PATIENTS** *Ibrahim Elmadfa, Baerbel Sturtzel, Alexa L. Meyer, Gerald Ohrenberger*
11:25-11:50	**THIOGLYCOSIDES IN OUR DAILY VEGETABLES?** *Patrick Rollin*
11:50-12:15	**IZAZOVI STVARANJA VRIJEDNOSTI ZA DIONIKE PREHRAMBENE INDUSTRIJE** **CHALLENGES FOR VALUE CREATION OF STAKEHOLDER FOR FOOD INDUSTRIES** *Jasmina Ranilović*
12:15-12:30	***Discussion and conclusions*** **Rasprava i zaključci**
12:30-12:45	***Break, Poster Session*** **Pauza, razgledavanje postera**

Sponsor presentation and Oral presentations /
Sponzorsko predavanje i Usmena priopćenja
***Moderators* / Moderatori:**
Marizela Šabanović, Danijela Skroza

12:45-13:00	**SHIMADZU RJEŠENJA ZA ANALIZE HRANE** **SHIMADZU SOLUTIONS FOR FOOD ANALYSIS** *Matea Potkrajčić, Shimadzu d.o.o.* *Sponsor presentation* / Sponzorsko predavanje
13:00-13:10	**NUTRITIVE COMPOSITION AND HEALTH BENEFITS OF FILLETED FISH** *Greta Krešić, Tanja Dinić, Ana Vulić, Nina Kudumija, Kristina Kvrgić, Jelka Pleadin*
13:10-13:20	**ULOGA AMBALAŽE U OSIGURAVANJU ZDRAVSTVENE ISPRAVNOSTI HRANE** **THE ROLE OF PACKAGING IN FOOD SAFETY** *Nataša Stipanelov Vrandečić*
13:20-13:30	**BIOLOGICAL ACTIVITY OF DIFFERENT TYPE OF ELDERBERRY WINE** *Milena Vujanović, Gökhan Zengin, Uroš Miljić, Tatjana Majkić, Ivana Beara, Saša Đurović, Marija Radojković*
13:30-13:45	***Discussion and conclusions*** **Rasprava i zaključci**
13:45-15:15	***Lunch break, Poster Session*** **Pauza za ručak, razgledavanje postera**

Oral presentations and Sponsor presentation /
Usmena priopćenja i Sponzorsko predavanje
***Moderators* / Moderatori:**
Ivana Flanjak, Ivana Mudnić

15:15-15:30	**MODERN APPROACHES TO DETERMINING FOOD CONTAMINANTS** *Neven Bublić, Alphachrom d.o.o.* *Sponsor presentation* / Sponzorsko predavanje
15:30-15:40	**VOLATILE COMPOUNDS OF MACEDONIAN DRY FERMENTED SAUSAGE (*SUDZUK*) DURING RIPENING** *Erhan Sulejmani, Muhamet Demiri, Adnan A. Hayaloglu*
15:40-15:50	**DRIJEN - ZABORAVLJENI IZVOR** **CORNELIAN CHERRY - FORGOTEN SOURCE** *Vedran Poljak, Lea Pollak, Frane Strikić, Leo Gracin, Mario Bjeliš, Josip Gotovac*
15:50-16:00	**RAZLIKE U KONZUMACIJI MLIJEKA I MLIJEČNIH PROIZVODA U PREHRANI ADOLESCENATA U ODNOSU NA SPOL I MJESTO BORAVKA** **DIFFERENCES IN CONSUMPTION OF MILK AND DAIRY PRODUCTS IN ADOLESCENT DIET ACCORDING TO THE GENDER AND THE PLACE OF RESIDENCE** *Irzada Taljić, Adela Delalić*
16:00-16:10	**HERBAL PRODUCTS AS POTENTIAL THERAPY FOR IRRITABLE BOWEL SYNDROME** *Ivan Vukoja, Filip Njavro, Anamarija Jurić, Jakov Ivković, Deni Rkman, Anita Galić*
16:10-16:20	**REZULTATI MONITORINGA OSTATAKA PESTICIDA U I NA HRANI BILJNOG PODRIJETLA NA TRŽIŠTU BOSNE I HERCEGOVINE U 2017.** **RESULTS MONITORING OF PESTICIDE RESIDUES IN OR ON FOOD OF PLANT ORIGIN IN BOSNIA AND HERZEGOVINA IN 2017** *Džemil Hajrić, Dragan Brenjo, Katica Arar, Dragan Tomović, Armin Čolaković, Ivana Zovko*
16:20-16:35	***Discussion and conclusions*** **Rasprava i zaključci**
16:35-16:50	***Coffee Break, Poster Session*** **Pauza za kavu, razgledavanje postera**

***Oral presentations /* Usmena priopćenja**
***Moderators* / Moderatori:**
Đurđica Ačkar, Ivana Generalić Mekinić

16:50-17:00	**FOOD FREQUENCY QUESTIONNAIRE ANALYSIS IN PATIENTS WITH HASHIMOTO'S TYROIDITIS** *Dean Kaličanin, Luka Brčić, Ana Barić, Sanda Gračan, Marko Brekalo, Vesela Torlak Lovrić, Ivana Kolčić, Ozren Polašek, Tatijana Zemunik, Ante Punda, Vesna Boraska Perica*
17:00-17:10	**POLYCYCLIC AROMATIC HYDROCARBONS IN SELECTED FOOD FROM CROATIAN MARKET** *Tanja Bogdanović, Sandra Petričević, Eddy Listeš, Jelka Pleadin*
17:10-17:20	**MICROBIOLOGICAL ANALYSIS AND DETERMINATION OF QUALITY OF WATER** *Enver Karahmet, Senita Salkić, Enisa Omanović-Mikličanin, Amir Ganić, Munevera Begić, Almir Toroman, Erna Čatić*
17:20-17:30	**UTJECAJ LOKACIJE I MODELA GNOJIDBE NA MINERALNI SASTAV LISTA I PLODA BARANJSKE ZAČINSKE PAPRIKE** **INFLUENCE OF LOCATION AND FERTILIZATION MODEL ON LEAF AND FRUIT MINERAL NUTRIENT COMPOSITION OF BARANYAN SPICE PEPPER** *Tomislav Vinković, Monika Tkalec, Brigita Popović, Jasna Kraljičak, Boris Ravnjak*
17:30-17:40	**MOGUĆNOST PROIZVODNJE ZDRAVSTVENO SIGURNE HRANE U TLIMA ONEČIŠĆENIM MANGANOM** **MANGANESE POLLUTION IN AGRICULTURAL SOILS WITH IMPLICATIONS FOR FOOD SAFETY** *Emir Šahinović, Hamdija Čivić, Senad Murtić*
17:40-17:55	***Discussion and conclusions*** **Rasprava i zaključci**
20:00	***Conference dinner*** **Zajednička večera**

Friday, October 19th 2018 / Petak, 19. listopada 2018.

08:30-09:00	***Registration of participants*** **Prijava i registracija sudionika**
	Plenary lectures and Invited lecture **/** **Plenarna predavanja i Pozvano predavanje** ***Moderators*** **/ Moderatori:** *Stela Jokić, Dražan Jozić*
09:00-09:25	**INFORMIRANJE POTROŠAČA O PRISUTNOSTI GLUTENA U HRANI** **INFORMATION TO CONSUMERS ABOUT PRESENCE OF GLUTEN IN FOOD** *Jelena Đugum, Sanja Kolarić Kravar, Marija Batinić Sermek*
09:25-09:50	**THE INFLUENCE OF DIET TO THE LEVEL OF INSULIN RESISTANCE AN CLINICAL COURSE OF FATTY LIVER** *Nizama Salihefendić, Muharem Zildžić, Midhat Jašić*
09:50-10:05	**FUNKCIONALNA HRANA BILJNOG PODRIJETLA U REGULACIJI ŠEĆERNE BOLESTI** **FUNCTIONAL FOOD OF PLANT ORIGIN IN DIABETES MELLITUS** *Roberta Petlevski* *Invited lecture /* Pozvano predavanje
10:05-10:20	***Discussion and conclusions*** **Rasprava i zaključci**
10:20-10:35	***Coffee Break, Poster Session*** **Pauza za kavu, razgledavanje postera**

Oral presentations and Sponsor presentation /
Usmena priopćenja i Sponzorsko predavanje
***Moderators* / Moderatori:**
Ante Lončarić, Zvonimir Marijanović

10:35-10:45	**NUTRIGENOMICS – THE SCIENCE OF THE 21st CENTURY, READY FOR PRIME TIME?** *Jasmina Timic, Sladjana Sobajic*
10:45-10:55	**DIETARY-THERAPEUTHIC APPROACH OF NON-INSULIN AND INSULIN THERAPY FOR DIABETES MELLITUS TYPE 2** *Inga Marković, Slađana Cvijanović Benke, Davor Cvijetić*
10:55-11:05	**n6/n3 OMJER LIPIDA HRANE I LIPOGENEZA U DIJABETESU: ŠTO MOŽEMO NAUČITI IZ ANIMALNIH MODELA** **DIETARY LIPID n6/n3 RATIO AND LIPOGENESIS IN DIABETES: WHAT CAN WE LEARN FROM ANIMAL MODELS** *Tomislav Mašek, Kristina Starčević*
11:05-11:15	**THE ROLE OF CELLULAR MECHANISM IN *Campylobacter jejuni* ADHERENCE** *Anja Klančnik, Katarina Šimunovič, Meta Sterniša, Barbara Jeršek, Sonja Smole Možina*
11:15-11:25	**STAVOVI I ZNANJA POTROŠAČA PREMA KVALITETI I SIGURNOSTI HRANE NA PODRUČJU FBIH** **ATTITUDES AND KNOWLEDGE OF CONSUMERS ACCORDING TO QUALITY AND SAFETY FOOD IN FB&H** *Ermina Kukić, Sead Karakaš, Mateja Paklarčić*
11:25-11:35	**PRIMJENA 3D PRINTANJA U PROIZVODNJI FUNKCIONALNE HRANE** **APPLICATION OF 3D TECHNOLOGY FOR FUNCTIONAL FOOD PRINTING** *Tomislava Vukušić, Višnja Stulić, Zoran Herceg*
11:35-10:45	**MIKOTOKSINI: UTJECAJ NA ZDRAVLJE I ANALITIKA** **MYCOTOXINS: THE IMPACT ON HEALTH AND ANALYTICS** *Martina Pavičić, Labena d.o.o.* *Sponsor presentation* / Sponzorsko predavanje
11:45-12:00	***Discussion and conclusions*** **Rasprava i zaključci**
12:00-12:15	***Break, Poster Session*** **Pauza, razgledavanje postera**

Scientific seminar „OLIVE OIL AS A FUNCTIONAL FOOD“
Znanstveni seminar „MASLINOVO ULJE KAO FUNKCIONALNA HRANA“
***Invited lectures* / Pozvana predavanja**
***Moderators* / Moderatori:**
Slobodan Brinić, Matko Erceg

12:15-12:30	**PHENOLIC SECOIRIDOIDS FROM EXTRA VIRGIN OLIVE OIL AND OLIVE OIL - HEALTH CLAIM** *Eleni Melliou, Prokopios Magiatis*
12:30-12:45	**PHENOLIC CHARACTERIZATION OF EXTRA VIRGIN OLIVE OIL FROM CROATIA** *Tea Bilušić* *Invited lecture /* Pozvano predavanje
12:45-13:00	**OLIVE OIL AS NATURAL SOURCE OF PHENOLIC COMPOUNDS** *Ivana Generalić Mekinić*
13:00-13:15	**ENCAPSULATION TECHNIQUES OF NATURAL BIOACTIVE COMPOUNDS** *Branko Bugarski, Verica Đorđević, Bojana Balanč, Ana Belščak-Cvitanović, Steva Lević, Kata Trifković, Ana Kalušević, Ivana Drvenica, Draženka Komes, Viktor Nedović*
13:15-13:30	***Discussion and conclusions*** **Rasprava i zaključci**
13:30-14:00	***Conclusions and Conference closing*** **Zaključci i zatvaranje Skupa**

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INFORMIRANJE POTROŠAČA O PRISUTNOSTI GLUTENA U HRANI

INFORMATION TO CONSUMERS ABOUT PRESENCE OF GLUTEN IN FOOD

Jelena Đugum, Sanja Kolarić Kravar*, Marija Batinić Sermek

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plenary lecture / plenarno predavanje

Označavanje hrane je jedno od najsloženijih zakonski uređenih područja vezanih za hranu kao i najvažniji trenutak u komunikaciji proizvođača hrane s potrošačem. Jedno od općih načela propisa o hrani je informiranje potrošača o hrani, a jedan od obveznih podataka na etiketi hrane je informacija o prisutnosti tvari ili proizvoda koji uzrokuju alergije ili intolerancije. Kada se koriste u proizvodnji hrane i prisutni su u toj hrani, određeni sastojci ili druge tvari ili proizvodi (kao što su pomoćne tvari u procesu proizvodnje) mogu uzrokovati alergije ili intolerancije kod nekih osoba, a neke od tih alergija ili intolerancija predstavljaju opasnost za zdravlje potrošača. Stoga je važno pružiti točne informacije o svim tvarima ili proizvodima u hrani koji uzrokuju alergije ili intolerancije kako bi potrošač mogao donijeti ispravnu odluku pri kupnji hrane i prilagoditi je svojim prehrambenim potrebama. EU zakonodavstvo naglašava 14 specifičnih alergena koji se koriste (kao sastojci ili pomoćne tvari) u proizvodnji ili pripremi hrane (uključujući i pića) i prisutni su u gotovom proizvodu čak i u promijenjenom obliku, a o čijoj prisutnosti informacije moraju biti pružene potrošaču. Među sastojcima koji uzrokuju alergije ili intolerancije nalaze se i žitarice koje sadrže gluten, tj. pšenica (poput pira i pšenice khorasan), raž, ječam, zob ili njihovi sojevi dobiveni hibridizacijom te proizvodi od tih žitarica. Osobe oboljele od celijakije boluju od trajne intolerancije na gluten. Gluten prisutan u tim žitaricama može kod osoba intolerantnih na gluten prouzročiti razna štetna djelovanja na zdravlje. Iz tog razloga takve osobe trebaju izbjegavati konzumaciju glutena i stoga gluten mora biti odsutan iz njihove prehrane ili smije biti prisutan u vrlo malim količinama. Provedbena uredba Komisije (EU) br. 828/2014 o zahtjevima za informiranje potrošača o odsutnosti ili smanjenoj prisutnosti glutena u hrani propisuje pravila o informiranju potrošača u pogledu odsutnosti („bez glutena") ili smanjene prisutnosti glutena („vrlo mali sadržaj glutena") u hrani. Također, u odnosu na prethodno zakonodavstvo, jasnije propisuje pravila informiranja osoba koje su intolerantne na gluten o razlici između hrane koja se izrađuje isključivo iz sastojaka koji prirodno ne sadrže gluten i koja je posebno formulirana za osobe intolerantne na gluten. Nova pravila se primjenjuju i za nepretpakiranu hranu.

Ključne riječi: alergeni, gluten, hrana, potrošači

Keywords: allergens, gluten, food, consumers

FOOD-BASED INTERVENTION TO IMPROVE THE NUTRITIONAL AND HEALTH STATUS IN GERIATRIC PATIENTS

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plenary lecture

Malnutrition and anaemia are common in elderly, presenting a serious threat to health in geriatric patients. The Micronutrient Intervention (MINT) study used a food-based approach to improve the nutritional and health status of elderly patients in geriatric care threatened by malnutrition especially with regards to anaemia. 99 elderly geriatric patients (mean age 84.9 ± 7.9) received nutrient-dense foods rich in highly available iron (offal, black pudding, oat bran) for twelve months, providing additional 4-5 mg/dl of iron, and also vitamin B_{12} and folate. Body height, weight and composition were measured. Erythrocyte counts and indicators of iron status, albumin, vitamin B_{12}, and folate were determined. Food intake was measured in a two-day weighted food record after 6 and 12 months.

The obtained results showed that energy and nutrient intake increased significantly. The nutritional status of the participants improved significantly over the study period, reflected by maintenance of body weight and of lean body mass with a higher percentage of patients with a phase angle ≥ 4° at t_1. In these patients, body composition also improved.

Anaemia prevalence decreased from 29% at baseline to 16.5%. Among the anaemic patients, iron status improved (haemoglobin: 12.2 vs. 11.2 g/dl, $p<0.05$; erythrocyte count: 4.34 vs. 4.02 M/mm^3, $p<0.05$; serum transferrin: 235.5 vs. 213.3 mg/dl, $p<0.05$; serum Fe: 62.9 vs. 56.1 µg/dl, n.s.) as did serum albumin (3.54 vs. 3.37 g/dl, $p<0.01$). In patients not suffering from anaemia, nutritional status was stable.

It could be concluded that nutrition status of geriatric patients was successfully improved by introducing nutrient-dense foods in the daily meal plan.

Keywords: geriatric patients, food-based intervention, malnutrition, anaemia, iron status

IZAZOVI STVARANJA VRIJEDNOSTI ZA DIONIKE PREHRAMBENE INDUSTRIJE

CHALLENGES FOR VALUE CREATION OF STAKEHOLDER FOR FOOD INDUSTRIES

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plenary lecture / plenarno predavanje

Strategijom pametne specijalizacije RH 2016-2020 u tematskim područjima „Hrana i bioekonomija" i „Zdravlje i kvaliteta života" sektor poljoprivredno-prehrambene industrije, prepoznat je kao nositelj dodane vrijednosti kroz razvoj nove, zdrave i funkcionalne, visokokvalitetne i sigurne, organski uzgojene hrane. Hrvatska prehrambena industrija osobito izvozno orijentirana, suočena je sa konkurencijom velikih multinacionalnih kompanija koja dodanu vrijednost hrane za krajnjeg potrošača, postavlja u daleko širi kontekst svojih dionika, čime se dugoročno ostvaruje temelj za održivi rast i razvoj. Integracija dionika, njezina usmjerenost na stvaranje vrijednosti i jasno komuniciranje, bit će ključni u ostvarenju konkurentske prednosti domaće prehrambene industrije.

Ključne riječi: hrana, prehrambena industrija, stvaranje vrijednosti, dionici

Keywords: food, food industry, value creation, stakeholder

THIOGLYCOSIDES IN OUR DAILY VEGETABLES?

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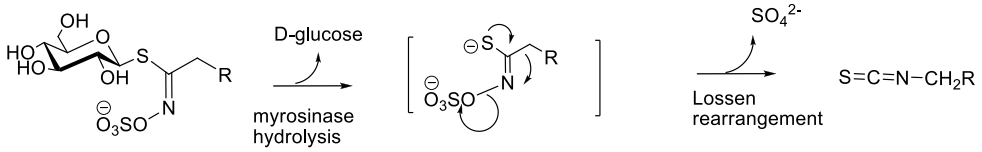
plenary lecture

The botanical order *Brassicales* - which encompasses many of our daily vegetables - is strikingly chemo-characterized by the presence of thiosaccharidic secondary metabolites called glucosinolates. Those atypical anomeric thioesters display a remarkable structural homogeneity over three parts: a β-D-glucopyrano unit, a *NO*-sulfated anomeric *(Z)*-thiohydroximate functional group and a rather hydrophobic side chain, the constitution of which is in the vast majority of cases the sole structural variant in Nature, according to plant species.
Associated in plants with an uncommon glucohydrolase - myrosinase (E.C.3.2.1.147) - glucosinolates usually operate like precursors to biologically active isothiocyanates:



Extraction of glucosinolates from appropriate vegetable sources can prove convenient in a number of cases to obtain pure compounds. Nevertheless, the chemical synthesis approach has appeared to be a more efficient way to access most of glucosinolates – either natural or artificial. Diversified synthetic approaches of glucosinolates and tailor-made analogues - mainly targeting the myrosinase inhibition process – have been developed over the last decades.
In other respects, the discovery of several odd chemo-enzymatic transformations of glucosinolates have sparked off, in our laboratory, investigations on less common organic thiofunctionalities, such as cyclic thionocarbamates and thio-imidate *N*-oxides.

Keywords: thioglycosides, vegetables, myrosinase

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THE INFLUENCE OF DIET TO THE LEVEL OF INSULIN RESISTANCE AN CLINICAL COURSE OF FATTY LIVER

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plenary lecture

Obesity, insulin resistance and fatty liver related to modern lifestyle are getting epidemic characteristics and present the most important world public health problem. Fatty liver and insulin resistance is especially important clinical entity which cautions on the possibility of development chronic diseases of all organs. Fatty liver has the important influence on mental and physical development of children. Disease has asymptomatic clinical course so primary prevention and screening in early childhood are the best way to prevent the beginning and expansion of the disease. Food and eating habits play a fundamental role in pathogenesis of insulin resistance and fatty liver. Current research shows that the digestive system has many important functions for keeping entire health with close realationship with brain. Disturbed function can lead to the development of a large number of autoimmune diseases and insulin resistance associated with fatty liver, diabetes type II, obesity and chronic cardiovascular disease.

The aim of the paper is to evaluate and summarize new knowledge about fatty liver, insulin resistance, eating habits and interaction with the brain and than to find evidence of positive effect of implementation the current dietary guidelines on the level insulin resistence and clinical course of fatty liver.

Current science has shown that food, eating habits and digestive functions have a strong and decisive influence on patogenesis insulin resistance, fatty liver and its clinical course, quality of life, and on the appearance of various diseases. Choosing healthy personal diet and healthy eating habits with a healthy lifestyle gives the opportunity to prevent insulin resistence and change clinical course of fatty liver, cardiovascular diseases , diabetes mellitus and meny other diseases

Better understanding of new key mechanisms of development insulin resistance and fatty liver lead to the development new therapeutic dietary and nutritional approaches.

Current treatment needs to be based on the principles of personal medicine and focused on healthy lifestyles including nutrition and physical activity.

Keywords: fatty liver, insulin resistance, primary prevention, food

***NUTRITION* /**
NUTRICIONIZAM

RISK FACTORS FOR ADVERSE PREGNANCY OUTCOMES IN PREGNANT WOMEN FROM THE UNA-SANA CANTON

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poster presentation

A number of woman's characteristics, including her age, health, state of nourishment, diet and lifestyle habits play important role in pregnancy outcomes. Study-specific, anonymous questionnaire was developed to assess dietary and lifestyle habits of pregnant women to identify risk factors that could potentially have adverse effect on pregnancy. A prospective, observational study was conducted on 200 pregnant women from the Una-Sana Canton, average age 28 years. Total of 21.5% of women entered pregnancy as overweight/obese, while 8.0% of women were underweight. High gestational weight gain was found in 34.0% of women, and women who enter pregnancy with higher BMI tend to gain excessive weight during gestation ($p=0.005$). Despite high prevalence of nausea (12.0% throughout pregnancy and 48.0% in the first trimester) and heart burn (30.0% throughout the pregnancy and 25.0% in the third trimester), only 36.0% of pregnant women were aware of the necessity to adapt/change their diet accordingly. Supplements are used by 63.0% of pregnant women (11.5% in the first trimester, 51.5% throughout the pregnancy). Also, older women ($p<0.001$) and those that planned pregnancy tend to use supplements throughout the pregnancy more often. Even 71.5% women said they planned pregnancy, therefore preconception education should be introduced to improve pregnancy outcomes.

Keywords: pregnancy, risk factors for pregnancy outcomes, state of nourishment, gestational weight gain, supplementation

FARMACEUTSKE FORME ŽELJEZA U DODACIMA PREHRANI

PHARMACEUTICAL FORMS OF IRON IN FOOD SUPPLEMENTS

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poster presentation / postersko priopćenje

Sideropenična anemija je danas relativno česta bolest kako u industrijski razvijenim zemljama tako i u zemljama u razvoju, koja je najčešće uzrokovana nedovoljnim unosom bioraspoloživog željeza s hranom. Ostali uzroci mogu biti brojni, pa se često koriste nadopune prehrani.
Cilj rada je bio analiza raspoloživih znanstvenih informacija, kao i podataka iz tržišne ponude dodataka prehrani koje sadrže željezo, o njihovom kemijskom sastavu, farmaceutskim formama i bioraspoloživosti.
U preparatima željeza te u dodacima prehrani često se koriste željezo-fumarat, željezo-sukcinat, željezo-glukonat, kao i forme željeza porijeklom iz hemoglobina. U tim preparatima željezo može biti dvovalentno i trovalentno. Značajniji preparati u komercijalnoj ponudi su: željezo (II) fumarat kapsule, željezo III hidroksid u ugljikohidratnom polimeru - polimaltozi, kompleks željezo (III) hidroksida sa saharozom, željezo (III) protein sukcinilat suspenzija i željezo (II) glukonat, mangan-glukonat i bakar-glukonat suspenzije.
Zbog bolje iskoristivosti formulacije, dodaci prehrani često sadrže i druge sastojke kao što su vitamin C, vitamin B_{12} (cijanokobalamin), vitamin B_9 (folnu kiselinu) i druge. Najčešće su dodaci u obliku kapsula i filmom obloženih tableta, a postoje i u tekućoj formi. Forma dodataka prehrani se uklapa u načela individualne prehrane i integrativne medicine, tako da se doze preparata i dijete trebaju međusobno harmonizirati.
Može se zaključiti kako pored prehrane koja je bogata željezom često su potrebne i nadopune različitim formama dodataka prehrani. Doza dodataka prehrani određuje se na osnovu procjene zdravstvenog i prehrambenog statusa kao i drugih čimbenika.

Ključne riječi: željezo, dodaci prehrani, anemija

Keywords: iron, dietary supplements, anemia

ZASTUPLJENOST MEDITERANSKE PREHRANE MEĐU GIMNAZIJALCIMA IZ SPLITA

MEDITERRANEAN DIET ADHERENCE AMONG HIGH SCHOOL STUDENTS FROM SPLIT

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poster presentation / postersko priopćenje

Mediteranska prehrana podrazumijeva svakodnevni unos cjelovitih žitarica, voća, povrća, maslinovog ulja i orašastih plodova, kao i svakodnevnu umjerenu konzumaciju crnog vina i mliječnih proizvoda, tjedni unos mahunarki, krumpira, ribe, jaja i peradi te vrlo nizak unos crvenog mesa i slatkiša. Cilj ovog rada bio je ispitati zastupljenost mediteranske prehrane među gimnazijalcima u Splitu.
Presječno istraživanje provedeno je tijekom svibnja 2018. g. među učenicima trećih razreda gimnazija iz Splita (n=503). Učenici su ispunili upitnik o prehrambenim navikama na temelju kojeg je izračunat indeks mediteranske prehrane.
Ukupno se 6,2 % učenika i 5,6 % učenica hranilo po principu mediteranske prehrane. Učenici su u najvećem postotku slijedili preporuke piramide mediteranske prehrane za krumpir (87,7 %). Primjerenu konzumaciju voća imalo je 55,6 % učenika, žitarica njih 30,5 %, dok je svakodnevna konzumacija povrća u najmanje 2 obroka zabilježena u 14,4 % učenika, a maslinovog ulja u 9,6 % učenika. Logističkom regresijom zabilježena je povezanost između mediteranske prehrane i ITM-a (OR 1,32; 95 % CI 1,09-1,6; P=0,004), sati provedenih sjedeći (OR 1,13; 95 % CI 1,01-1,25; P=0,027) i percepcije sreće (OR 1,61; 95 % CI 1,11-2,33; P=0,012). Može se zaključiti da je zabilježena izuzetno niska zastupljenost mediteranske prehrane među gimnazijalcima iz Splita. Potrebno je hitno uložiti napore u promoviranju ovog zdravog načina života.

Ključne riječi: mediteranska prehrana, gimnazijalci, ITM, Split

Keywords: Mediterranean diet, high school students, BMI, Split

KVALITETA PREHRANE BOLNIČKIH MEDICINSKIH SESTARA

DIET-QUALITY OF HOSPITAL NURSES

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poster presentation / postersko priopćenje

Medicinske sestre su osoblje koje najviše vremena tijekom bolničkog liječenja provede uz pacijenta što im daje mogućnost promocije zdravog stila života, ne samo brigom o zdravlju pacijenta već i vlastitim primjerom. Cilj ovog rada bio je utvrditi kvalitetu prehrane medicinskih sestara zaposlenih u KBC Rijeka. Pripadnost modelu mediteranske prehrane ispitana je među 203 medicinske sestre, korištenjem Indeksa mediteranske prehrane prema jedinicama serviranja (MDSS, engl. *Mediterranean Diet Serving Score*). Bodovanje je izvršeno na temelju količine i učestalosti konzumiranja pojedinih skupina namirnica pri čemu najveća vrijednost MDSS indeksa iznosi 24. Prosječna vrijednost MDSS indeksa među ispitanicama iznosila je 8,58 ± 3,81, što se može smatrati lošom pripadnošću mediteranskoj prehrani (MDSS≤14). Samo je 7 % ispitanica imalo prehranu u skladu s mediteranskom prehranom. Gotovo je trećina ispitanica imala prekomjernu tjelesnu masu (27 %) dok ih je sedmina bila pretila (13 %). Nije uočena statistički značajna povezanost kakvoće prehrane i stupnja obrazovanja (p=0,588), godina radnog staža (p=0,734), indeksa tjelesne mase (p=0,186) niti stupnja tjelesne aktivnosti (p=0,643). Analiza kvaliete prehrane medicinskih sestara pokazala je potrebu njenog unapređenja, u skladu s mediteranskom prehranom. Nužna je kontinuirana edukacija medicinskih sestara o pravilnim prehrambenim i životnim navikama kako bi unaprijedile svoju prehranu te što vjerodostojnije svojim primjerom doprinosile dobrobiti pacijenata.

Ključne riječi: bolničke medicinske sestre, indeks tjelesne mase, kakvoća prehrane, mediteranska prehrana, tjelesna aktivnost

Keywords: body mass index, diet quality, hospital nurses, mediterranean diet, physical activity

ODRŽIVOST KONZUMACIJE HRANE U HRVATSKOJ PROCIJENJENA VODENIM OTISKOM

SUSTAINABILITY OF FOOD CONSUMPTION IN CROATIA ESTIMATED WITH THE WATER FOOTPRINT

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poster presentation / postersko priopćenje

Suvremeni način prehrane postao je neodrživ kako u zdravstvenom tako i u ekološkom smislu. Sedamdeset posto pitke vode troši se u poljoprivredi, a rast populacije i zagađenje okoliša mogli bi uskoro dovesti do njenog nedostatka. Cilj ovog rada bio je procijeniti vodeni otisak potrošnje hrane kućanstva u Republici Hrvatskoj. Podaci o prosječnoj potrošnji hrane po članu kućanstva dobiveni su iz ankete o potrošnji kućanstva Državnog zavoda za statistiku, a izračun vodenog otiska pojedinih namirnica korišteni su podaci iz baza dostupnih na platformi *Water Footprint Network*. Prosječna osoba u Hrvatskoj samo unosom hrane potroši više od 1.221.169,4 L vode godišnje, odnosno 3.345,7 L dnevno. Najveće vodene otiske imaju skupine meso i proizvodi od mesa (39,9 %), kruh i žitarice (14,0 %), te mlijeko, sir i jaja (13,4 %), dok je utjecaj voća i povrća zastupljen u manjem udjelu (9,8 %). Istraživanje je potvrdilo da u Hrvatskoj, kao i u ostalim zapadnim zemljama, visoka konzumacija mesa i proizvoda životinjskog podrijetla zauzima veliki udio u vodenom otisku prehrane. Smanjenjem njihovog unosa osigurala bi se veća održivost prehrane u smislu potrošnje vode, ali i održanja zdravlja, u nadolazećem periodu nesigurnosti globalnog prehrambenog sustava.

Ključne riječi: konzumacija hrane, Hrvatska, održivost, vodeni otisak

Keywords: food consumption, Croatia, sustainability, water footprint

NUTRITIVE COMPOSITION AND HEALTH BENEFITS OF FILLETED FISH

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oral presentation

Fish represents high nutritional density food due to its low energy value but high content of protein, essential minerals and n-3 polyunsaturated fatty acids. Numerous evidences confirm that regular fish consumption is related to health benefits. Since modern consumers appreciate convenience, demand for frozen fish as a nutritious food that can be quickly prepared either at home or in catering establishments is continuously growing. This study investigated the nutritive composition of three commercially important filleted frozen fishes: Pacific salmon (*Oncorhynchus keta*), cod (*Pollachius virens*) and hake (*Merluccius hubbsi*). In three lots of fillets per each fish species, basic chemical parameters were determined using gravimetric and titrimetric methods whereas methyl esters of fatty acids were analysed by gas chromatography with flame ionization detection The obtained results showed the highest average amount of fat in hake (4.20 g/100 g), while salmon was the richest source of protein (20.26 g/100 g). Hake had significantly higher ($p < 0.05$) levels of n-6 and n-3 fatty acids, including a higher content of eicosapentaenoic (20:5 n-3 EPA), docosahexaenoic (22:6 n-3 DHA) and α-linolenic (18:3 n-3 ALA) acid, compared to the other two species. Data for recommended health indices support recommendations for regular fish consumption as part of a healthy diet.

Keywords: cod, fatty acids, hake, nutritive composition, salmon

UTJECAJ BOJE HRANE NA NJENU PRIHVATLJIVOST KOD POTROŠAČA

THE INFLUENCE OF FOOD COLOR ON CONSUMERS ACCEPTANCE

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Kompleksnost procesa donošenja odluke pri izboru hrane kao i čimbenici koji mogu utjecati na nju predmeti su brojnih istraživanja. Sve više pažnje se posvećuje utjecaju senzorskih karakteristika na odabir hrane među kojima boja ima jednu od vodećih uloga u formiranju ukupnog doživljaja prehrambenih proizvoda. Čovjek je oduvijek boju koristio kao indikator zrelosti/okusa, svježine tj. kvarenja namirnica. Postavlja se pitanje na koji način je ta korelacija boje i odabira proizvoda iskorištena danas. Budući da boja predstavlja vrlo moćan alat u svijetu marketinga u kojem ambalaža prodaje proizvod, promocija proizvoda boljih nutritivnih svojstava se može lakše postići dobrim odabirom pakiranja. Na temelju boje se stvara i pretpostavka o okusu. Izuzev povezanosti osnovnih okusa s određenim bojama, zaključci o okusu se oblikuju i na temelju intenziteta boje. Takve spoznaje uzrokovale su veću primjenu bojila kako bi se postigao što bolji vizualni dojam. Cilj ovoga rada je prikazati funkciju boje te način na koji ista utječe na podsvijest potrošača i konačno na njihov odabir hrane.

Ključne riječi: boja hrane, percepcija boje, preferencije potrošača, okus

Keywords: food color, color perception, consumer preferences, taste

FORMULATION OF SUNFLOWER AND FLAXSEED OIL BLENDS RICH IN OMEGA 3 FATTY ACIDS

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poster presentation

The recommendations of the World Health Organization (WHO) are aimed at increasing the consumption of foods rich in omega 3 fatty acids. The recommended ratio of omega 6 and omega 3 fatty acids in diet is 4-10 : 1, which allows muscle building, hormone production, reduces the risk of cardiovascular diseases, reduces blood pressure, triacylglycerols, improves brain functions, mood, intelligence etc. However, just some foods (eg. flaxseed oil, fish oils etc.) are rich in these compounds. The aim of this study was to examine the possibility of enriching refined sunflower oil (RSO) with omega 3 fatty acids by adding cold pressed flaxseed oil (CPFO). The initial samples were examined, refined sunflower oil and cold pressed oil of flax seed, their blends in the mass ratio 70:30, 50:50 and 30:70 and the obtained results were compared with the one blended vegetable oil present on the market of R. Serbia. The content of saturated fatty acids ranged from 9.63 to 10.32%, monounsaturated from 17.15 to 30.44% and polyunsaturated from 59.78 to 73.15%. The ratio of omega 6 : omega 3 fatty acids found in the samples was between 892.91 : 1 and 0.33 : 1.

Keywords: oil blends, flaxseed oil, omega 6 : omega 3 ratio

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THE GENERAL NUTRITION KNOWLEDGE OF PROFESSIONAL ATHLETES

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The nutrition of athletes is one of the most important factors of training and success in sports competitions. The aim of this study was to evaluate the nutrition knowledge among professional athletes and their non-athletes' peers. A cross-sectional study was conducted among 211 participants (110 professional athletes and 101 non-athletes) who undergone preventive examination by the specialist of occupational and sports medicine in Osijek, Eastern Croatia, during September 2017. A specially designed anonymous questionnaire served as a research tool. The median age of all study participants was 20.0 years (interquartile range 19.0-24.0 years); there were 74.4% males and 25.6% females. The overall proportion of correct answers to nutrition questions among all study participants was 27.6% (interquartile range 20.7%-41.4%). There were no statistically significant differences in proportion of correct answers between professional athletes and non-athletes as well as between males and females (p=0.584 and p=0.904, respectively). Furthermore, study did not find differences in proportion of correct answers regarding the educational level, self-perceived socioeconomic status and body mass index category of study participants (p=0.547, p=0.491 and p=0.459, respectively). The study showed highly unsatisfactory level of nutrition knowledge among both groups of study participants. Additional education about nutrition is needed.

Keywords: nutrition, knowledge, athletes, sports, education, Croatia

PREHRANA I DIJABETES MELLITUS II

NUTRITION AND DIABETES MELLITUS II

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Dijabetes mellitus II (inzulin-nezavisna šećerna bolest ili adultni (staračk) diabetes) razvija se zbog inzulinske rezistencije. Progresija ove bolesti je svakim danom sve veća. Način prehrane značajno utječe na regulaciju i tok šećerne bolesti, a samim tim i kvalitetu života. Piramida prehrane osoba sa šećernom bolešću tek se neznatno razlikuje od uobičajenih preporuka. Alternativa je tzv. Mediteranska prehrana, koja ima niži postotak ugljikohidrata, a veći postotak masnoća, tj. izrazit unos mononezasićenih masti (maslinovo ulje) i hrane bogate prehrambenim vlaknima.
Cilj ovog rada bio je dati pregled utjecaja makro i mikronutrijenata te ostalih sastojaka iz hrane na dijabetes mellitus II.
Prehrana kod dijabetes mellitusa II ima izuzetan značaj kako u pogledu vrste, tako i pogledu sastava i količine hrane koja se unosi. Kod ugljikohidrata važno je poticati unos zdravih izvora ugljikohidrata, a izbjegavati rafinirane jednostavne šećere. Treba voditi računa o količini proteina koja se konzumira, dok kod masti preferirati unos mononezasićenih i polinezasićenih masnih kiselina.
Može se zaključiti da su pravilna i uravnotežena prehrana, unos odgovarajućih ugljikohidrata, masti i proteina od velikog značaja za osobe oboljele od dijabetes mellitusa II. Posebna pažnja se mora posvetiti kvaliteti namirnica i uravnoteženim obrocima, ali i redovnoj fizičkoj aktivnosti i smanjenju stresa.

Ključne riječi: dijabetes mellitus II, makronutrijenti, mikronutrijenti

Keywords: diabetes mellitus II, macronutrients, micronutrients

PREHRANA I DODACI PREHRANI TIJEKOM TRUDNOĆE

NUTRITION AND SUPPLEMENTS DURING PREGNANCY

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Količina hranjivih tvari koje trudnica unosi treba biti usklađena sa stupnjem trudnoće, aktivnošću trudnice i specifičnim zahtjevima za normalan rast i razvoj fetusa. Cilj ovog rada bio je provesti istraživanje o prehrambenim navikama trudnica i uzimanja dodataka prehrani. U istraživanju je sudjelovalo 49 trudnica s područja grada Tuzle, starosti između 19 i 35 godina. Za prikupljanje podataka korišten je posebno kreirani Upitnik.
Od ukupnog broja trudnica 55 % svakodnevno konzumira tri do pet obroka. Svaki dan doručkuje 94 % ispitanica. Najveći broj ispitanica (33 %) za doručak jede *sandwich*, dok 31 % doručkuje žitarice. Svaki dan večera 68 % ispitanica. Voće jednom do dva puta dnevno konzumira 68 % ispitanica. Povrće u obliku jela 29 % ispitanica konzumira jednom dnevno. Povrće u obliku salate svakodnevno konzumira 44 % ispitanica. Brzu hranu ne jede 8 % ispitanica. Slatkiše svakodnevno konzumira 31 % ispitanica, a čak 24 % više puta na dan. Tijekom dana 54 % ispitanica popije 1,5 do dvije litre vode. Suplemente uzima 76 % ispitanica od početka trudnoće i dalje, 16 % ne koristi vitaminsko-mineralne dodatke prehrani. Konzumiranje slatkiša, preskakanje obroka, premalo voća i povrća, kao i nedovoljna hidratacija organizma su navike trudnica koje bi trebalo korigirati.

Ključne riječi: trudnoća, prehrambene navike, suplementacija

Keywords: pregnacy, eating habits, supplementation

PROCJENA UNOSA PROCESIRANE HRANE KOD MALE DJECE

ASSESSMENT OF PROCESSED FOOD INTAKE IN TODDLERS

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Unos procesirane hrane bogate šećerima, zasićenim mastima i trans masnim kiselinama, što je najčešće popraćeno smanjenim unosom vrijednih hranjivih tvari, može imati negativan utjecaj na rast i razvoj djeteta te predstavlja rizik za pojavu pretilosti i ostalih zdravstvenih komplikacija. Ovo istraživanje imalo je za cilj procijeniti unos procesirane hrane kod djece dobi 12-36 mjeseci, provjeriti postoji li razlika u unosu procesirane hrane s obzirom na starost djeteta, kućne prihode i majčin indeks tjelesne mase. U istraživanju je sudjelovalo 133 djece. Istraživanje je provedeno prikupljanjem podataka putem općeg upitnika te dnevnikom prehrane. Utvrđena je statistički značajna razlika u unosu mlijeka ($p = 0,033$) i ribe ($p = 0,01$) u korist djece starije od 24 mjeseca. Također, statistički značajna razlika postoji u konzumaciji jaja ($p = 0,001$) i mlijeka ($p = 0,05$) u djece iz kućanstava s manjim prihodima, te u konzumaciji ostale svježe hrane ($p = 0,017$) u djece majki s normalnim indeksom tjelesne mase. Iako razlika nije bila statistički značajna ipak starija mala djeca, djeca majki s većim ITM i djeca obitelji s višim prihodima unose manje svježe, a više ultraprocesirane hrane. Edukacija roditelja, o pravilnoj prehrani kod male djece izuzetno je važna, a sve u svrhu formiranja prihvatljivih prehrambenih navika od malih nogu i održavanja njihovog zdravlja u budućnosti.

Ključne riječi: mala djeca, pretilost, procesirana hrana, pravilna prehrana, energijski unos

Keywords: toddlers, obesity, processed food, healthy diet, energy intake

DVOMJESEČNI RAD S PRETILIM OSOBAMA U PROJEKTU 130+

TWO MONTHS LONG WORK WITH OBESE INDIVIDUALS IN PROJECT 130+

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Pretilost je stanje nastalo djelovanjem više čimbenika. Najčešće pretili pojedinci imaju niz pridruženih psihofizičkih problema te je prisutna društvena stigmatizacija. Cilj projekta bio je pružiti stručan pristup liječenju pretilosti za pet osoba koje imaju tjelesnu masu preko 130 kg, kako bi im se omogućilo stjecanje zdravih životnih navika, a time i trajan gubitak tjelesne mase uz posljedično popravljanje kvalitete života. U projekt 130+ bile su uključene tri osobe ženskog spola i dvije osobe muškog. Starosni raspon bio je od 35 do 42 godine. Napravljena je procjena prehrambenog statusa i navika pomoću upitnika. S ispitanicima su radili treneri, liječnik, nutricionist i psihoterapeut. Ispitanici su prolazili edukaciju o pravilnoj prehrani i načinu života kao i posebno kreirani trening. Na početku projekta prosječna tjelesna masa ispitanika bila je 152,74 kg. Nakon dva mjeseca prosječna tjelesna masa je smanjena za 13,42 kg i iznosila je 139,32 kg ($p<0,05$, $t=9,420$). Smanjeni su i opseg struka, bokova, nadlaktice i podlaktice, kao i omjer opsega struka i bokova. Iako je vremenski okvir projekta godinu dana, za samo dva mjeseca projekta došlo je do značajnog gubitka tjelesne mase, kao i do poboljšanja ostalih parametara praćenih u tijekom projekta. Ispitanici su usvojili značajne promjene navika u tjelesnoj aktivnosti, prehrani i pristupu svom problemu.

Ključne riječi: pretilost, tjelesna masa, prehrambene navike, kvaliteta života

Keywords: obesity, body weight, nutritional habits, life quality

ASSESSMENT OF NUTRITIONAL STATUS IN ELDERLY BY BODY MASS INDEX AND BIOELECTRIC IMPEDANCE

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poster presentation

Aging proces involves various physical and metabolic changes that have effect on individual nutritional needs and dietary habits. Physical activity, energy and nutrient intake have an important effect on changes in elderly, and may result in malnutrition or obesity. In this study, to determine nutritional status two methods have been used: body mass index and body composition measured by bioelectric impedance. 97 elderly people has participated in this study, ages 51 to 95, in wich 47 where from Residential home for elderly Đakovo and 50 of them lived in their own home. The BMI results showed that most participants were obese (60%) or overweight (26%), while body composition values indicate a high proportion of fatty tissue (41%) and low muscle mass (25%). Gender comparison of body composition values indicate that 67% of male participants have very high proportion of fatty tissue and 81% of them low muscle mass, while 46% of females have higher values in normal muscle mass and 13% of them lower in normal proportion of fatty tissue. Higher obesity rate was observed in the residental home participants (66%) with a higher proportion of fatty tissue and lower muscle mass values compared to the participants who live in their own home. Overall results show that most of the participants are overweight that can lead to cronic disease development and in addition reduce quality of life. Better education, motivation and raise of awareness in elderly and institution employees about proper nutrition and physical activity can have positive impact on nutrition status and life quality of elderly.

Keywords: nutritional status, body mass index, body composition, elderly

PREHRAMBENO PONAŠANJE RADNO AKTIVNE POPULACIJE HRVATSKE

EATING BEHAVIOUR IN WORKING-ACTIVE POPULATION OF CROATIA

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poster presentation / postersko priopćenje

Prehrambeno ponašanje ima utjecaj na kvalitetu prehrane te zdravlje ljudi, a zbog modernog načina života lošije prehrambene navike i neodgovarajuće prehrambeno ponašanje sve su češća pojava. Cilj rada bio je utvrditi prehrambeno ponašanje radno aktivne populacije Hrvatske, s naglaskom na učestalost konzumacije doručka, samostalnog pripremanja obroka i konzumacije obroka izvan kuće. Presječnim istraživanjem obuhvaćene su 132 radno aktivne odrasle osobe, dobi 18-65 godina. Podaci o prehrambenom ponašanju prikupljeni su validiranim upitnikom o učestalosti unosa hrane i pića (FFQ). Prema dobivenim rezultatima žene statistički značajno češće samostalno pripremaju svoje obroke (p=0,045), dok u pogledu učestalosti konzumiranja doručka i obroka izvan kuće nije bilo statistički značajne razlike s obzirom na spol. Svega je 53 % ispitanika navelo da svakodnevno konzumira doručak. Utvrđeno je i da žene statistički značajno češće koriste maslinovo ulje za pripremu hrane (p=0,028) te pečenje i prženje (p=0,011). Muškarci značajno češće konzumiraju obroke unutar 10 minuta (p=0,047) u usporedbi s ženama. S obzirom da je u određenog broja ispitanika utvrđeno neodgovarajuće prehrambeno ponašanje, što je moguća posljedica užurbanog načina života, potrebne su daljnje prospektivne studije na većem broju ispitanika poradi utvrđivanja njihove povezanosti. Također, potrebna je i kontinuirana edukacija ljudi s ciljem poboljšanja kvalitete života i prevencije oboljenja povezanih s prehranom.

Ključne riječi: prehrambeno ponašanje, radno aktivna populacija, doručak, konzumacija

Keywords: eating behaviour, working-active population, breakfast, consumption

METODE ZA PROCJENU KVALITETE ŽIVOTA

METHODS FOR ASSESING THE QUALITY OF LIFE

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poster presentation / postersko priopćenje

Kvaliteta života definira se kroz dva aspekta: općim (faktori koji utječu na život), te zdravstvenim (faktori koji su dio zdravlja). Razvijanje metoda za procjenu kvalitete života doprinosi razumijevanju faktora koji utječu na očuvanje zdravlja, ali i onih koji su doveli do bolesti.
Cilj ovog rada je na osnovu literaturnih izvora predstaviti osnovne alate za procjenu kvalitete života.
Praćenje kvalitete života obuhvaća fizičku, funkcionalnu, psihološku i socijalnu komponentu. Kvaliteta života može biti procijenjena: općim skalama ili profilima zdravlja, bolest specifičnim skalama i baterijama testova. Opće skale su podešene za većinu pacijenata, ali ne za ciljanu populaciju. Glavna prednost im je mogućnost detekcije relevatnih efekata bolesti i tretmana u različitim životnim oblastima. Dopuštaju upoređivanje rezultata kvalitete života različitih populacija. Bolest specifične skale postoje za moždani udar, reumatske bolesti, kardiovaskularne bolesti i karcinome. Mnogo su specifičnije i ne dozvoljavaju upoređivanje različitih populacija pacijenata. Baterije testova za upoređivanje pojedinih dimenzija i aspekata zdravlja mogu biti upotrijebljene kao instrumenti procjene kognitivnih funkcija, depresije, aktivnosti svakodnevnog života ili socijalnog funkcioniranja.
Kvaliteta života se odnosi na osobno blagostanje i životnu satisfakciju, mentalno i fizičko zdravlje, materijalno zadovoljstvo, interpersonalne odnose, posao, usavršavanje i rekreaciju. Razvijanje metoda za procjenu kvalitete života pomaže očuvanju zdravlja, opisivanju i praćenju bolesti i evaluaciju novih terapijskih procedura.

Ključne riječi: kvaliteta života, procjena, praćenje

Keywords: quality of life, assessment, monitoring

RAZLIKE U KONZUMACIJI MLIJEKA I MLIJEČNIH PROIZVODA U PREHRANI ADOLESCENATA U ODNOSU NA SPOL I MJESTO BORAVKA

DIFFERENCES IN CONSUMPTION OF MILK AND DAIRY PRODUCTS IN ADOLESCENT DIET ACCORDING TO THE GENDER AND THE PLACE OF RESIDENCE

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oral presentation / usmeno priopćenje

U adolescenciji dolazi do ubrzanog rasta, povećanja mišićne mase, sazrijevanja i povećane fizičke aktivnosti. Mlijeko je kompletna namirnica koja sadrži brojne nutrijente i zadovoljava potrebe organizma za kalcijem, magnezijem, selenom, riboflavinom, vitaminima B_{12} i B_5. Proteini u kravljem mlijeku su visoke kvalitete, sadrže dobro uravnotežen sastav svih esencijalnih aminokiselina, uključujući i lizin. Zbog navedenog provedeno je istraživanje o konzumaciji mlijeka i mliječnih proizvoda među adolescentima u Kantonu Sarajevo.
Studija je obuhvatila 630 ispitanika, 60 dječaka i 73 djevojčice iz ruralnog i 264 dječaka i 233 djevojčice iz urbanog dijela Kantona Sarajevo. Ispitanici su imali 13-15 godina starosti. Korištena anketa je klasificirana kao semikvantitativna, uključuje količinu i učestalost konzumiranja određene namirnice, te predstavlja modificirani upitnik korišten u sličnim istraživanjima među adolescentima u Kantonu Sarajevo.
Podaci su statistički obrađeni pomoću programa SPSS 20.0. Rezultati prema mjestu boravka pokazuju da je konzumacija mlijeka prisutnija u urbanom području. Količina konzumiranog mlijeka/jogurta/sira i mjesto boravka su statistički neovisni. Kad se uzmu u obzir spol i mjesto boravka, testovi pokazuju da postoji razlika u distribuciji dnevno konzumiranog mlijeka između urbanih i ruralnih područja među djevojčicama. Uzimajući u obzir samo spol, dječaci konzumiraju mlijeko i mliječne proizvode više nego djevojčice.

Ključne riječi: adolescenti, spol, mjesto boravka, mlijeko/mliječni proizvodi, rast i razvoj

Keywords: adolescents, gender, place of residence, milk/dairy products, growth and development

POSITIVE DIETARY HABITS AMONG STUDENTS IN NOVI SAD

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Studying is an important period of the life that encompasses a transition from the adolescence to the adulthood. During that period improper dietary habits can be developed. The aim of this study was to estimate dietary habits among students of the University of Novi Sad. Cross-sectional study was conducted in May 2018 on 4 faculties, which have at least one course on food and dietary habits and encompassed 514 participant (133 males and 381 females). Results revealed that only 11% of the participants' practices 5 meals daily and just 56% of them consumes breakfast. Regarding the food types, only 6% of the participants consumes fruits and only 5% of them vegetables more than once a day. At the same time, 92% of participant consumes meat few times a week and 77% of participants consumes fish at least once a week. Water consumption higher than 2 L daily was reported by only 29% of the students although 85% of participants reported water as their first choice of drinks. Altogether, obtained results indicate unhealthy practices among studies student population and the need for healthy lifestyles promotion with emphasis on the promotion of balanced nutrition.

Keywords: students, nutrition, food habits

NUTRIGENOMICS – THE SCIENCE OF THE 21st CENTURY, READY FOR PRIME TIME?

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oral presentation

The success of sequence human genome leads to increased understanding of the causes, and prevention of diseases. Such knowledge has made way for a new direction of molecular nutrition, nutrigenomics, which allows to provide insight into the interaction of the food and our genetic profile, and grants the possibility to develop appropriate methods to treat diseases. Tocopherol, biotin, zinc and bioactive substances in food (cahectins, flavones) influence the structure and gene expression. The excess of vitamin D leads to changes in mRNA stability. Iron in amount ≥15 mg/daily decreases the incidence of DNA disturbance in youth. Furher, vitamin B12, folate, niacin, vitamin E, retinol and calcium reduce incidence of DNA damages, while riboflavin, pantothenic acids and biotin deficiency increases the incidence of DNA disorder. EPA fatty acid is successful in reducing the gene expression in chondrocytes encoding enzymes with the function of cartilage degradation. *„DASH"* diet affects primarily people with AA genotype for angiotensinogen, while less effective in people with GG genotype. Gene variant (AA) for angiotensinogen encodes the circulating ANG protein which then affects the increase in blood pressure. Replacing GA codon (75G → A) in the promoter for the Apo-A_1 is associated with increased plasma concentrations of HDL-cholesterol, leading to discerase of cardiovascular diseases and the reason lies in potentional influence of polyunsaturated fatty acids. Anthocyanin from blueberries can reduce adhesion of monocytes to the cells endothelium-the initial step in the development of atherosclerosis. Endogenous cholesterol synthesis is associated with variability in the response to plant sterols, which is associated with genetic variations. The impact of common gene variants on polyphenol bio-efficacy have been considered, which may help establish dietary polyphenol intake recommendations.

Keywords: nutrigenomics, genome, food ingredients

DIETARY HABITS IN SALTY SNACK CONSUMPTION AND FACTORS ASSOCIATED WITH THEIR USAGE AMONG URBAN ADOLESCENTS IN SERBIA IN PREVIOUS 48 HOURS

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poster presentation

Adolescence represents a sensitive period of life, full of challenges, behavioral and physiological changes, as well as dieatry changes. Young people are prone to eat „*fast food*“ and *snacks*. The aim of the study was to explore dietary habits related to the consumption of salty snack products among urban-living adolescents from Serbia in the previous 48 hours.

Adolescents mostly consumed chips, popcorn, flips, peanuts and salted sticks in previous 48 hours. When we consider the amount of snacks used durnig 48 hours, the most common answers were: two packages, one small package of 50 g, or undetermined amount of snack products. When taking into account the period of the day, the answers were: „any time of the day“, followed by: „in the evening“ and „during whole day“. Participants consumed this kind of products mainly in front of the TV or computer, at a break time in college or at school breaks, and at home.

Based on the research results it can be concluded that this group of products is very popular among young people, and that there are differences in the type of favorite products, places of the consumption and the quantity of packaging, as well as the time of day when they are most commonly used.

Keywords: snack products, adolescents, eating behaviours

PREHRAMBENE NAVIKE GIMNAZIJALACA IZ SPLITA

EATING HABITS OF HIGH SCHOOL STUDENTS IN SPLIT

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poster presentation / postersko priopćenje

Zdrava prehrana je vrlo važna odrednica životnog stila jer pruža zaštitu od obolijevanja od kroničnih bolesti, zbog čega je važno usvojiti zdrave navike rano u životu.
Cilj ovog istraživanja bio je ispitati prehrambene navike učenika u Splitu. Učenici trećih razreda gimnazija u Splitu (n=503) anketirani su o prehrambenim navikama tijekom svibnja 2018. godine. Učenici oba spola u prosjeku su jeli 3 glavna obroka dnevno. Najmanje 5 dana u tjednu doručkuje 80,2 % učenika i 66,5 % učenica, dok doručak preskače njih 6,2 % i 6,5 %. Učenice su češće bile nezadovoljne svojim izgledom (34,9% nasuprot 15,3 % kod učenika) i češće su bile na dijeti za mršavljenje (37,8 % nasuprot 13,0 %). U tjednu prije anketiranja vagalo se 37 % učenika oba spola. Najčešće zastupljena užina bila je sendvič ili pecivo (učenici 70,8 %, učenice 61,5 %). Ukupno je 55,6 % učenika prijavilo kako barem jednom na dan konzumira voće, 53,1 % povrće, dok 39,2 % učenika najmanje jednom na dan konzumira maslinovo ulje. Informacijama o prehrani s interneta vjeruje 48,3 % učenika, ali ih 93,4 % smatra kako se gladovanjem ne može zdravo mršaviti.
Može se zaključiti kako je dio prehrambenih navika učenika zadovoljavajući, dok bi se neke trebalo poboljšati, posebice povećati učestalost svakodnevne konzumacije maslinovog ulja, voća i povrća.

Ključne riječi: prehrana, doručak, gimnazijalci, Split

Keywords: diet, breakfast, high school students, Split

ISPITIVANJE ZNANJA O PREHRANI RODITELJA DJECE SPORTAŠA I NJIHOVIH TRENERA

ANALYZING THE KNOWLEDGE OF PARENTS AND COACHES OF CHILDREN ATHLETES ABOUT NUTRITION

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Život i zdravlje čovjeka (od rođenja, kroz cijeli život) ovise o kisiku, vodi i o 40-ak esencijalnih spojeva, koje unosi hranom. Nedostatak bilo kojega remeti ravnotežu i rad organizma, što je preduvjet bolesti. Prehrana djece značajno nadilazi jednostavne životne potrebe za izvorom energije i gradivnih elemenata, a što je posebno naglašeno kod djece sportaša. Provedeno je randomizirano observacijsko istraživanje primjenom anonimnog, jednokratnog tripartitnog upitnika koji je uz suglasnost preuzet od Kineziološkog fakulteta Sveučilišta u Zagrebu. Istraživanjem je obuhvaćeno 120 roditelja djece iz škole nogometa i 10 trenera nogometa s područja Sarajeva. I kod roditelja i kod trenera je utvrđen veći broj točnih odgovora na pitanja o utjecaju prehrane i prehrambenih navika na sportsku izvedbu ($p<0,001$) i kod obje skupine je utvrđena statistički značajna negativna korelacija između broja točnih i netočnih odgovora, koja je bila izuzetno jaka kod trenera ($r = -0,847$). Iako nije utvrđena značajna razlika u broju točnih odgovora (roditelji 30,5 ± 6,6, treneri 28,2 ± 4,6), roditelji su imali značajno manje netočnih odgovora od trenera (16,4 ± 5,3 u usporedbi s 20,1 ± 4,5, $p = 0,035$). Međutim, roditelji se značajno manje, gotovo uopće ne informiraju o prehrani prilagođenoj sportu u usporedbi s trenerima ($p = 0,025$). Zanimljivo je da je prema izvoru informiranja o prehrani među trenerima utvrđeno kako oni koji se informiraju iz stručne literature i sami su sebi izvor informacija (stečenog formalnim i neformalnim obrazovanjem) imaju značajno manje točnih (24,5 ± 5,1) i veći broj netočnih odgovora (24,0 ± 4,5) u usporedbi s trenerima koji se educiraju iz popularnih časopisa, interneta i sličnih izvora (30,7 ± 2,1 točnih odgovora, $p = 0,026$ i 17,5 ± 2,1 netočnih odgovora, $p = 0,014$). Dobiveni rezultati ukazuju na potrebu kontinuirane i stručne edukacije trenera o važnosti pravilne prehrane prilagođene djetetu sportašu kako bi mu se pomoglo u sportskoj izvedbi, ali i prevenirali svi eventualni zdravstveni problemi, od pretilosti nadalje.

Ključne riječi: djeca sportaši, roditelji, treneri, znanje o prehrani, prehrambene navike

Keywords: children athletes, parents, coaches, nutrition knowledge, nutrition habits

DIETETICS AND DIET THERAPY /
DIJETETIKA I DIJETOTERAPIJA

SUVREMENE SPOZNAJE O UTJECAJU DIJETA I DODATAKA PREHRANI NA AUTIZAM

CONTEMPORARY KNOWLEDGE ON HOW DIET AND DIETARY SUPPLEMENTS INFLUENCE AUTISM SPECTRUM DISORDERS

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poster presentation / postersko priopćenje

Autizam je česta bolest kojoj se ne zna jasna etiologija, a samim tim se ne može odrediti ni tretman, a kao i kod svake bolesti prehrana i životne navike imaju određeni utjecaj. Cilj rada je bio prikupiti i analizirati znanstvene informacije o utjecaju dijeta i suplemenata na liječenje autizma.
Prevalencija autizma iznosi 5–15 ili 20 na 10000 djece u zavisnosti od dijagnostičkih kriterija koji se koriste. Autizam se češće javlja kod dječaka, i to u odnosu 3–4 : 1. Nije dokumentirana predispozicija za poremećaj na osnovu rase, etničkog ili geografskog porijekla i socioekonomskog statusa. Prevalencija autizma kod braće i sestara iznosi 4,5 %. Autizam je više od 200 puta češći među braćom i sestrama rođenim poslije autističnog djeteta nego u općoj populaciji. Najčešće korišteni suplementi u liječenju autizma su vitamini, minerali i drugi pripravci. Iz grupe vitamina najčešće se koriste: kalciferol, piridoksin i cijankobalamin. Od mineralna se koriste cink, magnezij i kalcij, a od ostalih značajni su omega-3 masne kiseline, karnitin i digestivni enzimi. Koristi se i zdrava dijeta bez kazeina i glutena.
Rezultati istraživanja pokazuju da sveobuhvatan dijetoterapijski protokol, koji uključuje određene suplemente i prilagodbu prehrane povoljno utječe na nutritivni status i stoga vjerovatno povećava funkcionalnu sposobnost mozga.

Ključne riječi: autizam, dijeta, suplementi

Keywords: Autism spectrum disorders, diet therapy, supplements

IDENTIFICATION OF NUTRITION-RELATED FACTORS IN PEOPLE WITH ALZHEIMER'S DISEASE AND OTHER DEMENTIAS

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The most common dementia globally is Alzheimer's disease (AD). This is a chronic, neurodegenerative disease with no known cure. People with AD have poor nutritional status which is shown to advance disease's course. Specific dietetic approaches are used to help prevent malnutrition and alleviate progression of AD. Study subjects were recruited at the Department of Neurology, University Hospital Osijek and Home for Elderly and Disabled Persons Osijek. Interview method was used to assess and compare diet quality and identify nutrition-related factors in people with AD and other dementias (ADD, n=12 aged 73.1±12.4 years) and their healthy counterparts (HC, n=33 aged 61.1±9.9 years). Diet quality was assessed by a semi-quantitative food frequency questionnaire and was analysed by three indexes: Dietary Approach to Stop Hypertension (DASH), Mediterranean diet (MeDi) and MIND (hybrid of DASH and MeDi). The results confirmed that poorer nutritional status of ADD patients is an independent risk factor (P=0.046). MeDi index was higher among ADD patients, but only higher number of meals per day and fewer meal skipping were confirmed as independent nutrition-related factors in ADD patients in comparison to HC. These findings show that despite better dietary habits, ADD patients should be monitored closely for their nutritional status.

Keywords: Alzheimer's disease, dementia, nutritional status, diet quality

OBRADA DEBLJINE: BOLNIČKI VS PRIVATNI POSJETITELJI

OBESITY TREATMENT: HOSPITAL VS PRIVATE NUTRITION COUNSELING

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poster presentation / postersko priopćenje

Uspoređivani su rezultati dvije skupine posjetitelja nutricionističkog savjetovališta: bolnički, čije troškove pokriva HZZO (54 ispitanika), i privatni, koji sami snose troškove obrade (224 ispitanika). Obje skupine obrađene su od strane istog ispitivača te su korištene identične metode edukacije. Analizom tjelesne mase Omron aparatom i ispitivanjem prehrambenih navika pomoću 24-satnog i FFQ testa dobiveni su osnovni podaci o ispitaniku na temelju čega se izrađuje individualni plan prehrane i provodi edukacija. Ispitanici iz obje skupine na kontrolni pregled dolazili su između 3 i 7 puta unutar tri mjeseca.
Ispitanici su bili podijeljeni u skupine prema spolu i pomoću t-testa definirane su razlike. Kod ženskih ispitanika u skupini bolnički zabilježen je gubitak na tjelesnoj masi od 2,90 %, dok u skupini privatni gubitak je iznosio 6,86 %. U skupini bolnički obrađenih muškaraca gubitak je bio 1,40 %, dok je kod skupine privatni to bilo 7,10 %. U obje skupine došlo je do statistički značajne razlike u gubitku postotka tjelesne mase. Rezultati pokazuju kako je utvrđena pozitivna korelacija po pitanju broja dolazaka, što znači da veći broj dolazaka podrazumijeva i veći gubitak kilograma. Ispitanici su bili upitani i o fizičkoj aktivnosti. Utvrđeno je kako ne postoji pozitivna korelacija u gubitku kilograma i vježbanju, ali bilježi se značaj napredak u gubitku masnog tkiva ispitanika koji su fizički aktivni.
Može se zaključiti kako se nutricionistička edukacija pokazala kao dobar izbor obrade pacijenata budući je 92 % ispitanika izgubilo na tjelesnoj masi (100 % iz skupine privatnih i 74 % iz skupine bolničkih), a osim toga važno je naglasiti kako su financije izvrstan motivator u promjeni životnog stila.

Ključne riječi: debljina, edukacija, nutricionističko savjetovalište

Keywords: obesity, education, nutrition counseling

UTJECAJ KONZUMIRANJA PLODA I LISTA BOROVNICE NA DIJABETES

THE EFFECTS OF CONSUMING FRUIT AND LEAF OF BLUEBERRIES ON DIABETES

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poster presentation / postersko priopćenje

Dijabetes mellitus tipa 2 u svijetu dostiže razmjere epidemije. Česte posljedice kroničnog dijabetesa su gubitak vida, amputacija ekstremiteta, bolesti bubrega, te druge bolesti iz sklopa metaboličkog sindroma. Osim medicinske i bihevioralne terapije u liječenju se koriste i određeni biljni pripravci te namirnice s posebnim utjecajem na dijabetes. S obzirom na sastav aktivnih komponenti određena istraživanja, a i narodna medicina ukazuju na utjecaj konzumiranja ploda i lista borovnice na smanjenje inzulinske rezistencije i razvoj dijabetesa. Cilj rada je bio prikupiti i analizirati podatke o utjecaju konzumiranja lista i ploda borovnice na regulaciju glikemije.

Plod borovnice je sezonsko voće koje se preporučuje osobama oboljelim od dijabetesa. Isto tako preporučuje se konzumiranje lista borovnice u vidu čaja. Plod borovnice sadrži flavonoide iz grupe antocijana i proantocijanida, moćnih antioksidanasa koji sprječavaju oksidativne procese i štite krvožilni sustav. List borovnice sadrži sastojak neomirtilin za kojeg istraživanja pokazuju jak pozitivan učinak na razinu glukoze u krvi. Posebno su značajni salicilati u borovnici koji utječu na koagulaciju i smanjuju vjerovatnoću kardiovaskularnih oboljenja.

Preporuka je da osobe koje boluju od dijabetesa povremeno konzumiraju čaj od lista borovnice te unose između 50 i 100 g plodova borovnice, osobito u sezoni.

Ključne riječi: dijabetes, borovnica, plod i list

Keywords: diabetes, blueberry, fruit and leaf

FOOD FREQUENCY QUESTIONNAIRE ANALYSIS IN PATIENTS WITH HASHIMOTO'S TYROIDITIS

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Genetic and environmental factors play a role in development of Hashimoto's thyroiditis (HT). As food intake is considered to be an important environmental factor, we aimed to evaluate food habits of HT patients, measured by self-reported food frequency questionnaire (FFQ). FFQ, composed of 51 food-items, was collected from 491 HT cases and 433 controls originating from the region of Split. Prior analysis, we grouped food items into 22 food groups and calculated weekly intake of each food group per individual. We analysed differences in weekly intake of 22 food groups between HT cases and controls to identify specific foods that are consumed more or less frequently in HT cases than in controls. Food groups that are more frequently consumed in HT patients were animal fat, processed meat and nuts whereas whole grains, caloric drinks, red meat, plant oil, olive oil, hard liquor, blue fish and fruits were less frequently consumed. Animal fat has already been associated with high thyroid peroxidase antibodies that are key markers of HT. We have narrowed down the list of potential food factors that may play a role in HT status. Our results are observational and need to be confirmed in interventional trail.

Keywords: Hashimoto's thyroiditis, food frequency questionnaire, diet

DIETARY-THERAPEUTHIC APPROACH OF NON-INSULIN AND INSULIN THERAPY FOR DIABETES MELLITUS TYPE 2

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oral presentation

Basic principles of treatment of diabetes are dietary therapy, adapted physical activity on daily basis and continuous education about treatments. When effects of this approach are not satisfactory, than pharmacological treatment is introduced. The aim of this study was to emphasize necessity of individual dietary-therapeutic approach to pharmacological therapy for diabetes mellitus type 2. Individualized dietary-therapeutic approach is based on monitoring and evaluation of biochemical, metabolic and anthropometric parameters of diabetes mellitus patients within Diabetes and Nutrition Counselling Department. Anthropometric research is done on InBody analyzer by method of direct segmental analysis of multi frequent bioelectrical impedance (DSM-BIA Method) - tetra polar system with 8 touching points. Selection of dietary therapy is based on characteristic of medication, presence of other metabolic disorders and overall health of the patient with the aim of good control of glycaemia. Researches indicate that optimisation of metabolic control prevents chronic complications. Decrease of HbA1C for 1% lowers risk of myocardial infarction for 14%, micro-vascular complications for 37% and mortality from diabetes for 21%. The aim of joint integrated approach in treatment is to lower risk from macro and micro vascular events with reaching satisfactory values of glycosylated hemoglobin (HbA1c) with fasting glycemia <7.2 mmol/L, postprandial glycemia <8.0 mmol/L. The latest recommendation for optimal value of HbA1c is value under 7% with individual approach to a patient.
Case overview: Patient age 52 was referred by Internal Medicine Specialist to Diabetes and Nutrition Counselling Department for glycemia regulation. Values of HbA1c on last analysis was 10.3% (86 mmol/L) with measured fasting glycaemia of 12.2 mmol/L. Patient was educated about diabetic nutrition with individualized dietary-therapeutic approach. Control findings have indicated that introduction of appropriate diet therapy and education led to regulation of glycemia based of following measured values: HbA1c 7.1% (53 mmol/L), fasting glycemia 9.5 mmol/L with regulation of other biochemical parameters. It could be concluded that individualized dietary-therapeutic approach to pharmacological therapy of diabetes mellitus type 2 improves effects of medication, insulin and non-insulin therapy.

Keywords: dietotherapy approach, diabetes mellitus 2

n6/n3 OMJER LIPIDA HRANE I LIPOGENEZA U DIJABETESU: ŠTO MOŽEMO NAUČITI IZ ANIMALNIH MODELA

DIETARY LIPID n6/n3 RATIO AND LIPOGENESIS IN DIABETES: WHAT CAN WE LEARN FROM ANIMAL MODELS

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oral presentation / usmeno priopćenje

Masne kiseline sadržane u organizmu mogu potjecati iz hrane, biti sintetizirane *de novo* ili pretvorene u različite višestruko nezasićene masne kiseline (biokonverzija). Regulacija koraka biokonverzije uključuje desaturaze i elongaze, kao i različite metabolite (glukoza), hormoni (inzulin) i transkripcijski čimbenike te mikroRNA. Prehrana (dostupnost supstrata) i konkurencija za enzime koji ograničavaju razinu desaturacije, kao i particioniranje u oksidaciju mogu bitno pridonijeti ili čak nadjačati druge regulatorne mehanizme. Dodatno, n6/n3 omjer lipida hrane postao je značajan dio znanstvenih istraživanja nakon otkrića kako osim koncentracija pojedinih masnih kiselina i omjer n6 prema n3 masnim kiselinama ima značajan utjecaj na zdravlje. Kod metaboličkih bolesti, poput dijabetesa i metaboličkog sindroma, dolazi do promjena u lipogenezi u različitim tkivima. Posljedično, profil masnih kiseline jetre i masnog tkiva (glavna mjesta lipogeneze) se značajno mijenja što može imati posljedice i na ostale organe koji ovise o dotoku masnih kiselina iz jetre i masnog tkiva putem cirkulacije. Korištenje animalnih modela za istraživanje lipogeneze tijekom metaboličkih bolesti je izazovno zbog vrlo složene regulacije lipogeneze jetre, kao i raznolikosti animalnih modela u pogledu vrste i soja. Dodatni izazov su razlike u prehrambenim i farmakološkim intervencijama koje se koriste za stvaranje dijabetesa tipa 1 ili 2 ili metaboličkog sindroma.

Ključne riječi: lipogeneza, n6/n3 omjer lipida, animalni modeli, dijabetes, metabolički sindrom

Keywords: lipogenesis, n6/n3 ratio, animal models, diabetes, metabolic syndrome

SASTOJCI IZ HRANE S POSEBNIM UČINKOM KOD ANGINE PEKTORIS

INGREDIENTS FROM FOOD WITH SPECIAL EFFECT AT ANGINA PECTORIS

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Angina pektoris je simptom ishemije miokarda koji je rezultat narušene ravnoteže između dostupnosti i potreba miokarda za kisikom. Kao posljedica se javljaju bolovi u području prsnog koša, ekstremiteta, malaksalost, a najčešće završava infarktom miokarda. Cilj i zadatak rada je bio na osnovi znanstvenih informacija istražiti sastojke iz hrane s učincima na stanje angine pektoris te istražiti koje dodatke prehrani u tu svrhu nudi farmaceutska industrija. Faktori rizika razvoja angine pektoris su: genetski (obiteljska povijest prerane kardiovaskularne bolesti), dob i spol, zatim bihevioralni (prehrana, pretilost, fizička neaktivnost, pušenje, produljeni psihosocijalni stres) i drugi. Neke bolesti, kao što su hipertenzija, dijabetes, dislipidemija, ili bolest bubrega (mikroalbuminurija) doprinose razvoju angine pektoris. Prehrana i sastojci iz hrane mogu imati značajan utjecaj na stanje krvožilnog sustava i angine pektoris. Način djelovanja tih sastojaka ogleda se u smanjenju razvoja ateroskleroze, usporavanjem inflamacije, poboljšanim antioksidativnim i fibrinolitičkim djelovanjima te utjecajem na lipidni status. Prepoznatljivo antiinflamatorno djelovanje imaju omega-3 masne kiseline, kapsaicini iz paprike, gingerol i zingerol iz đumbira, bromelain iz ananasa, alijum spojevi luka te sastojci veprine i šparoge. Antioksidativno djelovanje imaju vitamini C i E, minerali cink i selen, te karotenoidi kao što je likopen, kao i brojni polifenoli i flavonoidi. Na kaogulaciju krvi utječu vitamin K te acetilsalicilna kiselina. Aglutinaciju izazivaju lektinski proteini, a sprječavaju sastojci kurkume, borovnice, češnjaka i luka. Na nastajanje plaka i lipidni status utječu brojni faktori, što potvrđuje objašnjenje njihovog utjecaja na anginu pektoris. Zaključno se može reći da prehrana i dodaci prehrani mogu biti potpora u smanjenju simptoma angine pektoris, naročito uz bihevioralnu terapiju.

Ključne riječi: angina pektoris, prevencija, prehrana, dodaci prehrani

Keywords: angina pectoris, prevention, nutrition, dietary supplements

RIZICI I BENEFITI KUHINJSKE SOLI U HRANI

RISKS AND BENEFITS OF TABLE SALT IN FOOD

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Kuhinjska sol ili natrijev klorid jedan je od najzastupljenijih spojeva na Zemlji, neophodan za rad ljudskog organizma. Svakodnevnim unosom pridonosimo okusu naše hrane, a s kuhinjskom soli unosimo i jod neophodan za rad i razvoj organizma. Unos joda od osobite je važnosti za zdravlje, dok nedovoljan unos uzrokuje brojne razvojne i funkcionalne poremećaje, koji se nazivaju poremećaji uzrokovani nedostatkom joda (eng. *Iodine deficiency disorders* - IDD). Međutim, pretjeran unos kuhinjske soli ima dugoročno loše posljedice po zdravlje. Veliki broj epidemioloških istraživanja potvrđuje da je kuhinjska sol (NaCl) tj. natrij važan čimbenik koji određuje visinu arterijskog tlaka, a time i prevalenciju arterijske hipertenzije. Opažena je povezanost unosa kuhinjske soli s koronarnom bolesti, hipertrofijom lijeve klijetke, moždanim udarom te bolestima bubrega. Prosječan unos kuhinjske soli u Republici Hrvatskoj dvostruko veći od preporučenog dnevnog unosa od 5-6 g, i iznosi čak 11,6 g po odrasloj osobi. O učinkovitosti redukcije unosa soli na sniženje krvnog tlaka i redukciju rizika od kardiovaskularnih bolesti kod oboljelih od hipertenzije, danas postoje brojni dokazi. Umjerena redukcija unosa soli, odnosno dnevni unos soli prema preporukama, vodi do značajnog i klinički važnog sniženja krvnog tlaka kod osoba s ranom progresijom šećerne bolesti s normalnim ili blago povišenim vrijednostima krvnog tlaka. Smanjenje unosa kuhinjske soli za 3 grama dnevno može, na populacijskoj razini, dovesti do snižavanja arterijskog tlaka za 1-2 mmHg te rezultirati smanjivanjem pobola i smrtnosti. Dokazano je da se treningom konzumenata percepcija slanog okusa može prilagoditi, te smanjiti količina soli u proizvodima bez posljedica na svojstva, sigurnost proizvoda i preferenciju brenda kod potrošača.

Ključne riječi: kuhinjska sol, jod, sigurnost, hipertenzija

Keywords: table salt, iodine, safety, hypertension

STAVOVI OBOLJELIH/IZLIJEČENIH OD KARCINOMA DEBELOG CRIJEVA PREMA PREHRANI U MEĐIMURSKOJ ŽUPANIJI

ATTITUDES TOWARDS DIET OF PEOPLE WHO ARE SUFFERING FROM/WHO HAVE BEAT COLORECTAL CANCER IN MEĐIMURJE COUNTY

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Zbog svoje frekventnosti, karcinom debelog crijeva predstavlja velik javno zdravstveni problem koji u određenoj mjeri može biti kontroliran modifikacijom prehrane.
Cilj istraživanja bio je ispitati stavove oboljelih, odnosno izliječenih, od karcinoma debelog crijeva prema prehrani te njihove razlike s obzirom na dob, spol te trenutno zdravstveno stanje.
Istraživanje je provedeno u obliku dobrovoljne i anonimne ankete na odjelima dnevne bolnice, abdominalne kirurgije, gastroenterologije i onkologije Županijske bolnice Čakovec, ambulantama obiteljske medicine u sklopu Doma zdravlja Čakovec, udruge ILCO Čakovec te među dobrovoljnim sudionicima.
Reprezentativan uzorak činila je 61 osoba koje su odgovarale na 19 pitanja postavljenih onima oboljelim od karcinoma debelog crijeva, odnosno 20 pitanja postavljenih izliječenima od istog. Mogućnost upisivanja odgovora postojala je kod 4 pitanja, dok su pri ostalima odgovori bili ponuđeni. Podaci su obrađeni deskriptivnom statistikom.
Dobiveni rezultati pokazuju da iako svega 67,2 % ispitanih smatra kako je njihov način prehrane bio faktor rizika za nastanak bolesti, njih 88,5 % modificiralo je prehranu nakon postavljene dijagnoze. Vodeću poziciju među namirnicama izbačenim iz prehrane zauzima meso, a među onim uvedenim to je povrće.
Ispitanici provedenog istraživanja pridaju manju pozornost prevenciji nego liječenju već nastalog karcinoma debelog crijeva, a motiviranost za promjenom u prehrani pada proporcionalno prolazu vremena.

Ključne riječi: karcinoma debelog crijeva, prehrana, medicinska sestra, edukacija

Keywords: colon cancer, diet, nurse, education

THE IMPACT OF EDUCATION ABOUT SPECIFIC COOKING METHODS ON SERUM POTASSIUM LEVELS IN PATIENTS ON HEMODIALYSIS

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poster presentation

Progression of chronic kidney disease often results with developing hyperkalemia; the increased serum concentration of potassium, which causes cardiac, neuromuscular and gastrointestinal complications. Hyperkalemia is generally associated with cardiac arhythmias and higher risk of mortality in patients on hemodialysis.
The aim was to determine the impact of education, based on potassium-reducing techniques during food preparation and application of diet prepared according to learned techniques, on outcomes and potassium control compared to standard education program among patients on hemodialysis.
Subjects were 47 patients on hemodialysis divided in control and intervention groups. All subjects were educated by trained dietitian about proper nutrition and received appropriate materials at the beginning of the 1-year longitudinal study. The intervention group was educated additionally on potassium-reducing food preparation techniques and received two hospital meals per day when on hemodialysis, prepared accordingly to suggested methods. Anthropometric and biochemical parameters were monitored during the study.
The results showed there was statistically significant reduction in serum concentrations of potassium between control and intervention group at the end of the study ($p=0.037$).
Additional education about food preparation and proper diet alterations can be useful in decreasing serum potassium levels and preventing hyperkalemia in patients on hemodialysis.

Keywords: hemodialysis, hyperkalemia, potassium, cooking methods

FUNCTIONAL FOOD AND DIETARY SUPPLEMENTS / FUNKCIONALNA HRANA I DODACI PREHRANI

"WATER IN OIL" MICROEMULSION SYSTEM AS A POTENTIAL ENCAPSULATION SYSTEM OF ALLICIN

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poster presentation

Microemulsions are clear, thermodynamically stable, isotropic liquid mixtures of oil, water and surfactant or surfactant mixture. Olive oil is an excellent dispersing medium for "water in oil" microemulsions as it helps hydrate the skin and enhances the release of the active ingredients. In this study, surfactant mixtures containing Span 80 with Tween 80 series at various ratios were prepared with olive oil and water to produce "water in oil" microemulsions. The best results and largest microemulsions area result at 5:1 Span 80/Tween 80 ratio. Further, a microemulsion olive oil/water/mixed surfactant (67:4:29 by weight) was selected from the constructed phase diagram for further physical characterization. The microemulsions sample had a droplet size distribution with a PDI value of 0.388 ± 0.010 and droplet size of 40.43 ± 4.15 nm which indicates that a stable microemulsion was formed. The visual examination experiment was carried out over a period of 6 months in weekly intervals for the first 3 months and monthly intervals for the subsequent months. The visual observation showed no evidence of phase separation or any precipitation or flocculation. The selected microemusion sample will be used for encapsulation of allicin and to study the *in vitro* release.

Keywords: microemulsions, olive oil, encapsulation, allicin

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MICRO- AND NANO-ENCAPSULATION IN FOOD INDUSTRY

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poster presentation

Encapsulation can be defined as a process to entrap one substance within another substance producing particles with diameters of a few nm to a few mm. The entrapped material is usually a liquid, but may be a solid or a gas. The main reason of using the encapsulation process is the fact that some nutrients do not remain in the food for a significant amount of time or may react with the other food components causing undesirable effects. It is possible to use micro- and nano-encapsulation techniques. The first one, that is microencapsulation is a technology that can improve the retention time of the nutrient in the food and allow controlled release at specific times, during food consumption or in the intestinal gut (microencapsulation of vitamine). Nanoencapsulation has the potential to protect sensitive bioactive food ingredients from unfavorable environmental conditions, enhance solubilization, improve taste and odor masking, and enhance bioavailability of poorly absorbable function ingredients.

Keywords: microencapsulation, nanoencapsulation, food industry

EXTRACTION AND STRUCTURAL CHARACTERIZATION OF LACTOSE FROM RAW AND PROCESSED MILK

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poster presentation

Lactose is the main carbohydrate in milk, known as only significant source of lactose. Lactose or milk sugar is a disaccharide consisting of galactose and glucose, linked by a β-1-4 O-glycosidic bond. Lactose naturally occurs in either of two solid forms, α-monohydrate and anhydrous β form, or as amorphous glass- mixture of α- and β- lactose. Milk sugar has been shown to be very beneficial for the humans as lactose from milk represents a ready source of energy for infants. Milk sugar is a prebiotic, it can help establish and maintain a healthy microflora digestive system. Galactose, *component of lactos*e, is an essential nutrient for normal cell development and functioning of the human body. In pharmaceutical industry lactose is the most used excipient in solid oral drugs formulations. Extraction of lactose from milk can be done by solvent extraction method, which was used in this work. Six different milk samples were analysed, three technologically treated milk samples and three raw milk samples. Two of the six samples showed the highest level of obtained lactose. Unprocessed, raw sheep and buffalo milk contains around 83% of lactose. With successful derivatization of lactose and preparation of lactosazone, confirmation of lactose presence in all analysed samples of milk was obtained. Structural and chemical characterisation of extracted lactose was performed by melting point determination and Fourier Transform Infrared spectroscopy (FTIR).

Keywords: milk, lactose, sugar, extraction, FTIR

SALT, AS A FUNCTIONAL FOOD – IODINE

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Iodine deficiency and excessive salt intake are global problems for the population of the Earth. In terms of nutrition, table salt is the main source of Na and Cl ions for humans and animals. Its proper intake is vital for life. Salt plays a significant role as a nutrient necessary to maintain homeostasis of the human body. Except in diet, salt is also used in medicine, chemical and food industry. Every person needs a different amounts of salt depending on the age, weight, climate, humidity, physical activity, health status, the amount of the potassium intake and others. Average consumption per capita on a global scale is 10 grams per day or 3.5 - 4.5 kg per year. Out of total daily salt intake, 20% is from foods that contain salt, 15% is from subsequent adding salt to the food and 70% is from so called „hidden salt".

Industrial production of salt, its relative low cost and modern lifestyle have created habits of consuming foods with increased amounts of salt which results in increased death rates by stroke and heart attack, hypertension and heart, kidney and stomach diseases. All of which are reasons why WHO recommends consuming no more than 5 - 6 grams of salt per day. Salt substitution is also recommended, among which the use of KCl salts is preferred.

About 2 billion people have insufficient iodine intake. Low iodine intake can lead to goiter, retardation and cretinism. Sufficient iodine intake prevents the development of cancer (breast, ovary, uterus, prostate, and thyroid) and enhances the immune response of the body to fight bacteriological, viral, parasitic and fungal infections. By nutritional fortification with iodine, the table salt has become the main source of iodine. Chemical compounds used for iodination are KI, NaI and KIO_3. Daily iodine intake, recommended by International institutions (WHO, UNICEF and ICCIDD), is 150 mcg and they also recommend to add 20 - 40 mJ per kilogram of salt during iodination.

Bearing in mind all these problems with excessive salt intake on the one hand, and the fact that it is one of the most important sources of iodine whose intake is often insufficient on the other hand, the recommendation of salt intake should be in line with the iodination guidelines of salt, so that solving one problem does not result in the expansion of the other.

Keywords: iodinated salt, salt consumption, iodine deficiency

PONAŠANJE I STAVOVI STUDENATA VELEUČILIŠTA „MARKO MARULIĆ" U KNINU O FUNKCIONALNIM NAPITCIMA

BEHAVIOR AND ATTITUDES OF STUDENTS OF THE „MARKO MARULIĆ" POLYTECHNIC OF KNIN TOWARD FUNCTIONAL BEVERAGES

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poster presentation / postersko priopćenje

U radu su ispitani ponašanje i stavovi studenata Veleučilišta „Marko Marulić" u Kninu o funkcionalnim napitcima (FN) (uključivo sportski napitci; bez mliječno-baziranih napitaka) te je dana usporedba s učestalošću konzumacije sokova od voća i/ili povrća (SVP), sokova domaće proizvodnje (SDP) i energetskih pića s visokim sadržajem kofeina (EPK). Ispitivanje je provedeno od 05.-15.10.2015. godine putem otisnutog anketnog upitnika među dobrovoljnim studentima kojima je omogućena anonimnost. Korištena su pitanja zatvorenog tipa koja su obuhvatila opće podatke, te podatke o ponašanju i stavovima studenata o funkcionalnim napitcima. Dobiveni podaci obrađeni su jednovarijantnim analizama podataka.
Rezultati ispitivanja pokazuju da napitke deklarirane kao funkcionalni sokovi konzumiraju svi ispitanici. SDP ne konzumira 23,91 % ispitanika, 26,09 % konzumira ih barem jednom dnevno, a 19,57 % barem jednom tjedno. EPK nikada ne konzumira 45,65 % ispitanika, 13,04 % konzumira ih barem jednom dnevno, te 13,04 % barem jednom tjedno. SVP barem jednom dnevno konzumira 39,13 % ispitanika, barem jednom tjedno 34,78 %, dok 10,87 % ispitanika ih nikada ne konzumira. Domaća proizvodnja (43,48 %) najznačajniji je razlog za kupnju SDP, a utjecaj na organizam (39,13 %), te kvaliteta proizvoda (36,96 %) najznačajniji su razlozi za kupnju FN i EPK. Najčešće navođeni proizvodi su sokovi od bazge, cikle, drenjina, jabuke i grožđa, te brendovi „Vindi Iso sport" i „Red Bull".

Ključne riječi: funkcionalni napitci, studenti, ponašanje potrošača, stavovi

Keywords: functional beverages, students, consumer behaviour, attitudes

PRISUTNOST BETA-GLUKANA U DODACIMA PREHRANI NA TRŽIŠTU BOSNE I HERCEGOVINE

PRESENCE OF BETA-GLUCANS IN FOOD SUPPLEMENTS ON THE MARKET OF BOSNIA AND HERZEGOVINA

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poster presentation / postersko priopćenje

Cilj ovog rada bio je utvrditi prisutnost beta-glukana u dodacima prehrani na tržištu Bosne i Hercegovine, s posebnim naglaskom na količinu sastojaka u pojedinačnoj dozi. Tijekom 2015. godine provedena je analiza tržišta u 250 ljekarni, gdje je izvršen pregled asortimana dodataka prehrani koji sadrže beta-glukane. Rezultati su pokazali da je početkom 2015. godine bio oskudan broj preparata na tržištu, a tek krajem 2015. godine zabilježen je veći broj preparata koji sadrže beta-glukane, a posebno je značajno što su beta-glukani dostupni u različitim formama koje su prihvatljive za primjenu i kod djece i odraslih. Sve veći broj kliničkih studija o povoljnim utjecajima beta-glukana na zdravlje ljudi doveo je do masovnije proizvodnje i ponude takvih preparata. Analizom količine beta-glukana u pojedinačnoj dozi utvrđeno je da se za većinu proizvoda količina beta-glukana kreće u rasponu 200-300 mg po dozi, dok postoje i oni koji imaju značajno više (500 mg) ili značajno manje (20 mg) doze. Iako terapijska doza prema uzrastu, spolu i stanju nije utvrđena kontroliranim, već samo pojedinačnim studijama, predložena preporučena doza beta-glukana za minimalnu učinkovitost polazi od koncentracije 2-4 mg/kg tjelesne težine dnevno. Iz navedenog se može zaključiti da većina proizvođača nudi preparate s pojedinačnim dozama koje se kreću u okvirima preporučenih doza.

Ključne riječi: beta-glukani, dodaci prehrani, preporučena doza

Keywords: beta-glucans, food supplements, recommended dose

UPOTREBA DODATAKA PREHRANI KOD DIJABETES MELITUSSA II

USE OF DIETARY SUPPLEMENTS IN DIABETES MELLITUS II

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poster presentation / postersko priopćenje

Važnu ulogu u prehrani pacijenata s dijagnozom dijabetes mellitus-a II ima suplementacija koja treba biti pravovremena i pod kontrolom liječnika. Cilj je bio provesti istraživanje o upotrebi dodataka prehrani kod osoba oboljelih od diabetes mellitusa II.
U istraživanju provedenom u lijekarnama, sudjelovalo je 30 magistara farmacije s područja Tuzle i okolice. Za prikupljanje podataka korišten je posebno kreirani Upitnik, a podaci su statistički obrađeni.
Dobiveni rezultati pokazuju da pacijenti iznad 50 godina češće koriste dodatke prehrani. Magistri farmacije smatraju da su dodaci prehrani važni i najčešće preporučuju krom, cimet, alfalipoičnu kiselinu, cink, vitamine B kompleksa te kombinacije. Pacijenti se najčešće odlučuju za vitamine i to B kompleks, kombinaciju vitamina C s drugim vitaminima, kao i alfa lipoičnu kiselinu i koenzim Q10. Od minerala najčešće koriste krom, magnezij i cink. Primjenjuju se još list borovnice, zeleni čaj, list koprive i sok od *Aloe vere*. Na kupovinu se odlučuju na preporuku liječnika i farmaceuta, a prednost daju tabletama s čistim sastojcima.
Može se zaključiti da edukacija o pravilnoj suplementaciji može doprinijeti boljem i kvalitetnijem životu. Pacijent mora biti svjestan da dijetetski suplementi ne mogu, niti smiju zamijeniti lijekove za dijabetes, fizički aktivan stil života i dijetetski režim.

Ključne riječi: dijabetes mellitus II, suplementacija

Keywords: diabetes mellitus II, suplementation

UPOTREBA SAMONIKLOG BILJA ĐAKOVŠTINE U PREHRANI I LIJEČENJU

THE USE OF WILD PLANTS IN ĐAKOVŠTINA AREA FOR FOOD AND HEALING

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Unatoč vrlo raznolikoj flori na području Hrvatske, danas se za prehranu i liječenje različitih oboljenja koristi svega nekoliko desetaka samoniklih biljnih vrsta. Istraživanje primjene samoniklog bilja provedeno je putem anketnog upitnika na uzorku od 26 ispitanika s područja Đakovštine, u razdoblju od studenog 2016. do srpnja 2017. godine. Ispitanici su bili većinom ženskog spola, srednjoškolskog obrazovanja i prosječne starosti 54 godine. Utvrđeno ja da ispitanici koriste ukupno 38 biljnih svojti iz 24 porodice, a najveći broj svojti pripada porodicama Rosaceae, Asteraceae i Lamiaceae. Većina ispitanika upotrebljava bazgu, pasju ružu (šipak), koprivu, maslačak, kamilicu i gospinu travu. Najčešće prikupljaju i koriste listove i cvjetove, a od prikupljenog biljnog materijala izrađuju različite pripravke kao što su čajevi, masti, tinkture, macerati, sirupi, sokovi, likeri ili rakije. Pojedine biljne svojte koriste u obliku džemova, salata, i začina za prehranu, dok većinu biljaka koriste za jačanje organizma, liječenje respiratornih, gastrointestinalnih, dermatoloških i urooloških bolesti te za jačanje i regulaciju kardiovaskularnog sustava. Kako bi se dobili potpuniji podatci o tradicionalnoj upotrebi samoniklog bilja na području Đakovštine potrebna su daljnja istraživanja čiji će rezultati poslužiti u očuvanju i široj primjeni značajnih biljnih svojti ovog dijela Hrvatske.

Ključne riječi: etnobotanika, jestivo bilje, ljekovito bilje, istočna Hrvatska

Keywords: ethnobotany, edible plants, medicinal plants, east Croatia

NUTRITIVNA VRIJEDNOST I ZDRAVSTVENA ISPRAVNOST DO-DO ZAČINA

NUTRITIONAL VALUE AND HEALTH SAFETY OF DO-DO SPICES

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DO–DO začin je nutrijent iznimne kvalitete na bazi soli namijenjen konzumaciji krajnjeg potrošača. Primjenjuje u pojačavanju okusa hrane, a dodaje se kod pripreme jela kako bi obogatio okus. Proces proizvodnje DO-DO začina je šaržni proces, a sve sirovine koje se koriste zadovoljavaju svojom kvalitetom. Prema usvojenoj recepturi tvornice Solana d.d. Tuzla iste komponente se miješaju dok se ne postigne potpuna homogenizacija smjese. Uz primjenu implementiranih standarda ISO 9001:2015, ISO 22000:2005, HACCP, HALAL BAS 1049:2010 i KOSHER vrši se konstantni monitoring procesa proizvodnje i pakiranja. Nutritivna vrijednost prisutnih tvari u DO-DO začinu iznosi 494 kJ (116 kcal), a zbog prisustosti začinskog bilja i mogućnosti gubitka nutritivnih svojstva začinskog bilja najbolje je dodavati ga pred kraj kuhanja. Cilj tvornice Solana d.d. Tuzla jest proizvesti zdravstveno ispravan i nutritivno vrijedan DO-DO začin, jer ono što se unosi u organizam gradi ga i mijenja, a istovreme utječe na zdravlje i život.

Ključne riječi: DO-DO začin, nutritivna vrijednost, zdravstevna ispravnost

Keywords: DO-DO spices, nutritional value, health safety

ULJE CRNOG KIMA KAO DODATAK MEDU

BLACK SEED OIL AS AN ADDITIVE TO HONEY

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Nigella sativa u narodu poznata kao crni kim ili ćurekot je biljka s bogatom povijesnom i religijskom pozadinom još prije nego su znanstvenici počeli proučavati njen široki spektar farmaceutskog potencijala. Sjemenke crnog kima bogate su raznim sastojcima među kojima se ističu: aminokiseline, masne kiseline, proteini, steroli, razni esencijalni metali, ugljikohidrati, masti te voda. Ulje je žute boje, koja ukazuje na prisustnost žutih pigmenata (karotenoinda). Oksidativna stabilnost ulja crnog kima može trajati i do 55 sati, pri čemu ulje koje ima veću količinu polifenola je stabilnije. U radu je ispitivan antioksidativni kapacitet kao mjerilo kvalitete. Određen je antioksidativni kapacitet ulja crnog kima, meda i smjese meda i ulja metodom FRAP i DPPH. Kao otapalo korišten je metanol. Rezultati su pokazali da se dodatkom ulja crnog kima medu mogu poboljšati antioksidativna svojstva meda.

Ključne riječi: med, ulje crnog kima, antioksidativni kapacitet

Keywords: honey, black seed oil, antioxidative capacity

UTJECAJ DODATKA BAGREMOVOG MEDA I POLENOVIH ZRNA NA FERMENTACIJU I SVOJSTVA JOGURTA OD SOJINOG NAPITKA

EFFECTS OF ADDING ACACIA HONEY AND POLLEN GRAINS TO FERMENTATION AND PROPERTIES OF YOGURT FROM SOY DRINKS

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Fermentirani mliječni proizvodi zbog visoke nutritivne vrijednosti, terapeutskih svojstava, primjene probiotika i prebiotika povoljno djeluju na zdravlje ljudi i njihova potrošnja je u stalnom porastu. Cilj rada je bio ispitati utjecaj dodatka bagremovog meda i polenovih zrna na brzinu fermentacije, senzorska, fizikalno-kemijska i reološka svojstva, kao i na prihvatljivost probiotičkog sojinog napitka. U jedan dio uzoraka sojinog napitka dodane su određene koncentracije bagremovog meda (4,5; 5,5 i 7,0%), a u drugi dio koncentracije polena (0,3; 0,6 i 0,9%). Kao kontrola korišteni su uzorci bez dodatka meda i polenovih zrna. Inokulacija uzoraka je vršena probiotičkom monokulturom *Lactobacillus acidophillus La-5*. Proizvedeni uzorci su ohlađeni, te čuvani u hladnjaku na + 4 °C u trajanju od 8 do 9 sati zavisno od vrste uzorka. Ocjenjivanje senzorskih svojstva fermentiranih mliječnih napitaka provela je panel skupina od 11 senzorskih analitičara metodom bodovanja. Mjerenje fizikalno-kemijskih i reoloških karakteristika provodila su se nakon fermentacije 1., 7., 14. i 21. dan. Dodatak polenovih zrna je imao pozitivan učinak na reološka i negativan učinak na senzorska svojstva, dok je dodatak bagremovog meda pokazao pozitivan učinak na brzinu fermentacije, senzorska, fizikalno-kemijska i reološka svojstva, kao i na prihvatljivost probiotičkog sojinog napitka koja je provedena prvi dan nakon fermentacije.

Ključne riječi: fermentirano mlijeko, bagremov med, polen, sojin napitak, prihvatljivost

Keywords: fermented milk, acacia honey, pollen, soybean beverage, acceptability

FUNKCIONALNA HRANA BILJNOG PODRIJETLA U REGULACIJI ŠEĆERNE BOLESTI

FUNCTIONAL FOOD OF PLANT ORIGIN IN DIABETES MELLITUS

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invited lecture / pozvano predavanje

Funkcionalne komponente hrane mogu se učinkovito primjeniti u liječenju i prevenciji bolesti, a čine ih različite biomolekule koje imaju sposobnost moduliranja metaboličkih procesa u tijelu, što rezultira zdravstvenim blagodatima u kroničnih bolesnika, pa tako i kod onih koji boluju od šećerne bolesti tipa 2. Brojna znanstvena istraživanja su pokazala da se šećerna bolest tipa 2 i njene komplikacije mogu odgoditi, a postojeće stanje poboljšati redovitim unosom funkcionalnih komponenata hrane koje mogu utjecati na kontrolu glikemije, npr. poboljšanjem sekrecije inzulina i unosa glukoze u stanice mišićnog i masnog tkiva, inhibiranjem intestinalne apsorpcije glukoze, smanjenjem proizvodnje glukoze od strane jetre, regulacijom antioksidacijskih enzima, suzbijanjem proizvodnje proupalnih citokina i drugim mehanizmima. Komponente hrane kao što su polifenoli, poglavito flavonoidi, zatim steroli, nezasićene masne kiseline, biljna vlakna, vitamini i minerali pokazali su klinički značajne prednosti u šećernoj bolesti tipa 2. Stoga bi trebalo razmotriti personalizirani pristup u sprječavanju i upravljanju ovom bolesti, uvođenjem prehrambene edukacije o dobrobitima funkcionalne hrane, koja bi tako i u budućnosti mogla postati novi način razmišljanja o odnosima između hrane i zdravlja.

Ključne riječi: funkcionalna hrana, šećerna bolest, prevencija

Keywords: functional foods, diabetes mellitus, prevention

IN VITRO DIGESTIJA KAO MODEL POGODAN ZA ISPITIVANJE OTPUŠTANJA, STABILNOSTI I BIODOSTUPNOSTI BIOAKTIVNIH KOMPONENTI

IN VITRO DIGESTION AS MODEL FOR INVESTIGATION OF RELEASE, STABILITY AND BIOACCESSIBILITY OF BIOACTIVE COMPOUNDS

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poster presentation / postersko priopćenje

U znanstvenoj literaturi, koja je fokusirana na istraživanje i dokazivanje biološke aktivnosti različitih komponenti hrane, u posljednje vrijeme javlja se potreba za ispitivanjem njihove "sudbine" nakon gastrointestinalne digestije. Biološki aktivne komponente, kao što su peptidi, polifenoli i flavonoidi, karotenoidi, probiotici i prebiotici itd. su uglavnom kemijski i termički nestabilni, podložni oksidaciji i drugim utjecajima. Stoga, njihovo otpuštanje, stabilnost i dostupnost tijekom prolaska kroz probavni trakt može biti narušena. Kako su *in vivo* ispitivanja vremenski i financijski zahtjevna, sve više su zastupljeni *in vitro* testovi koji simuliraju fiziološke uvjete *in vivo* digestije i predstavljaju korisne alate za ispitivanje i razumijevanje promjena, interakcije, kao i biodostupnosti nutrijenata, bio- i farmakološki-aktivnih komponenti. Ovi testovi su široko zastupljeni u područjima ispitivanja hrane, farmakologije i kemije hrane. Tijekom posljednjih 30-tak godina, sve više je istraživačkih članaka koji uključuju ispitivanje digestije pomoću *in vitro* testova u cilju objašnjenja različitih gledišta koji se odnose na probavljivost proteina, interakcije nutrijenata kao i oslobađanje inkapsuliranih komponenti ili mikroorganizama. Najnoviji trend u primjeni ove tehnike odnosi se na određivanje antioksidativne aktivnost bioaktivnih komponenti poslije digestije. Cilj ovog rada je prikazati utjecaj gastrointestinalnog sustava na oslobađanje, stabilnost, kemijske interakcije matriksa i biodostupnost bioaktivnih komponenti različitog porijekla primjenom *in vitro* testova digestije.

Ključne riječi: *in vitro* digestija, bioaktivne komponente, biodostupnost, antioksidansi

Keywords: *in vitro* digestion, bioactive compaunds,bioaccesibility, antioxidant

UTJECAJ INKAPSULACIJE CIKLODEKSTRINIMA NA ANTIRADIKALNU UČINKOVITOST NUTRICEUTIKA IZ KOMINE MASLINE U BIOLOŠKIM MODELIMA

IMPACT OF CYCLODEXTRINS ON ANTIRADICAL ACTIVITY OF OLIVE POMACE - BASED NUTRACEUTICAL IN BIOLOGICAL MODEL SYSTEMS

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Noviji metodološki pristupi mjerenja antioksidacijske aktivnosti mjere sposobnost "hvatanja" slobodnih radikala, ali uzimaju u obzir i interakcije potencijalnih antioksidansa s biološki važnim molekulama, sposobnost prodora u intracelularni prostor te sposobnost akumulacije u pojedinim staničnim odjeljcima. U ovom radu analizirana je antioksidacijska sposobnost ekstrakata komine masline inkapsuliranih ciklodekstrinima (β-CD, hidroksipropil β-CD (HPβ), nasumično metilirani β-CD (RAMEB) i γ-CD) prema prethodno optimiranom postupku, u odnosu na nativni uzorak. Istražena je njihova sposobnost inhibicije cijepanja plazmidne DNA, antioksidacijska aktivnost na fosfolipidnom modelu membrane te inhibicija produkcije reaktivnih kisikovih spojeva (ROS) na staničnom modelu. Antioksidacijska aktivnost ekstrakata određena ORAC metodom varirala je od 11,3-15,97 mg Trolox ekvivalenata (TE)/g te nije utvrđen značajan učinak inkapsulicije ciklodekstrinima na antioksidacijsku aktivnost. Istraživanja protektivnog učinka na DNA pokazala su značajno niže EC_{50} vrijednosti (koncentracije uzoraka potrebne za 50 %-tnu zaštitu DNA od kidanja) za RAMEB i HP-β (53 g/L i 64 g/L) u odnosu na nativni uzorak (81 g/L). Sposbnost inhibicije lipidne perioksidacije također je bila značajno veća za RAMEB i HP-β (34 i 26 %). Istraživanje na HepG2 stanicama pokazalo je maksimalnu sposobnost inhibicije stvaranja ROS-a pri koncentraciji od 5 mg/mL, gdje je HP-β značajno jače inhibirao stvaranje ROS-a. Korišteni biološki modeli jasno ukazuju na bolju učinkovitost RAMEB i HP-β što nije bilo moguće utvrditi standardnim (i najčešće korištenim) ORAC testom.

Ključne riječi: ekstrakt komine masline, antioksidacijska aktivnost, ciklodekstrini, ROS

Keywords: olive pomace extract, antioxidant activity, cyclodextrins, ROS

STUDIES ON BIOLOGICAL ACTIVITY OF ELDERBERRY JUICE: NEW SOURCE OF NATURAL PRODUCTS TO IMPROVE HEALTH IN THE FORMULATION OF FUNCTIONAL PRODUCTS

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poster presentation

Elderberry fruit belongs to the wild berry category and is grown in Europe and North America. Elderberries have been traditionally used for medicinal purposes. Fresh, mature fruits of elder are harvested and crushed. After crushing, the made juice was filtered through a filter paper and thus separated from the impurities. Antioxidant potential of elderberry juice was analyzed using several different *in vitro* antioxidant assays: ABTS (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid), DPPH (2,2-diphenyl-1-picrylhydrazyl), CUPRAC (cupric reducing antioxidant capacity) and phosphomolybdenum assay. Total phenolic, total flavonoid and total anthocyanins content were determined spectrophotometrically and their contents amounted 47.95±1.01 mg galic acid/g juice, 4.84±0.10 mg rutin/g juice and 30.85±2.46 μg eq c*yanidin-3-glucoside*/mg juice, respectively. Also, a polyphenol profile was performed using the HPLC method, which it was detected 27 compounds. Enzyme inhibitory effects were tested against cholinesterase, tyrosinase, amylase and glucosidase. The strongest antioxidant activity of the tested juice was demonstrated by the use of CUPRAC test 143.77±1.49 mg kojic acid/g juice while the best enzyme inhibitory activity was achieved according to the enzyme tyrosinase 8.78±0.73mg kojic acid/g juice. Thanks to the good biological activity and high content of secondary metabolites, fruit juice of elderberry is a potential functional product, which could prevent the development of certain diseases.

Keywords: elderberry, juice, biological activity, functional food

PROTEOLYSIS AND ANTIOXIDANT PROPERTIES OF SOME MACEDONIAN TRADITIONAL CHEESES COMBINED WITH DIFFERENT HERBS

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poster presentation

Cheeses contain lipids that are highly susceptible to oxidation and the use of a natural medical and aromatic herbs may be beneficial in increasing the shelf life and sensory acceptability of these products as well. Natural plant-based antioxidants can be used to control the excess formation of free radicals and increase the antioxidant capacity. The overall objective of this investigation was to investigate the uses of a natural different herbs (*Mentha longifolia*, *Origanum vulgare*, *Thymus longicaulus*, *Alium sativum*, *Mentha longifolia*, *Petroselinum crispum*) to inhibit oxidation and proteolityc changes in cheeses. Cheese samples were taken to determine the water-soluble nitrogen (WSN) and 12% *trichloroacetic acid*-soluble nitrogen (TCA-SN) as percentage of total nitrogen (TN) by Kjeldahl method and total free amino acid (FAA) by a spectrophotometric method.
The antioxidant activities of the cheeses are determined as 2,2-diphenyl-1-picrylhydrazyl (DPPH) free-radical scavenging activity. The significant ($p<0.05$) antioxidant effect was observed in the *Mentha longifolia* fortified cheese comparing to free herbs cheeses, showing 297.05 and 79.53 mg trolox /kg antioxidant effects in the DPPH assays, respectively.

Keywords: proteolysis, free radicals, antioxidants, total free amino acids

DEVELOPMENT OF FUNCTIONAL PRODUCTS BASED ON POMEGRANATE PEEL THROUGH INNOVATIVE EXTRACTION TECHNOLOGY

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poster presentation

Punica granatum fruit possess various nutritive and medicinal benefits and represents an important source of bioactive compounds. However, pomegranate fruit peel, which is mainly treated as waste, is considered to be a potential source of bioactive constituents. Subcritical water extraction, an emerging environmental-friendly technology, was applied in order to obtain extracts on pomegranate fruit peel basis. Influence of temperature (100 - 220 °C) and extraction time (5 - 30 min) on quality of extracts was investigated, while pressure was kept constant (30 bar). In obtained extracts content of polyphenols (phenols and flavonoids) was determined by using spectrophotometric methods. In addition, antioxidant activity of extracts was determined by applying DPPH assay.

A significant rise in the content of phenols was noted with the increase in temperature from 100 to 160 °C, and 160 °C being the point at which the highest content of total phenols was obtained (14.16 g GAE/100 g dry weight). Same pattern was noticed in flavonoids as well, and at constant extraction time of 10 minutes, the highest content of flavonoids was measured in the extract obtained at the temperature of 160 °C (2.13 g GAE/100 g dry weight). It is determined that content of polyphenols in extracts did not correlate with the antioxidant activity of extracts. Longer time of extraction is favourable for the higher antioxidant activity. However, extracts obtained at temperatures which provide the highest antioxidant activity of extracts are also rich in phenols and flavonoids. Therefore, the results of the study point out that it is possible to produce high quality products based on pomegranate waste with low expenses.

Keywords: *Punica granatum*, subcritical water extraction, phenols, antioxidant activity

ANTIOKSIDATIVNA AKTIVNOST POLIFENOLA IZ KOMINE MASLINE U MODELIMA HRANE

ANTIOXIDANT ACTIVITY OF OLIVE POMACE POLYPHENOLS IN FOOD MODEL SYSTEMS

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poster presentation / postersko priopćenje

Komina masline je otpad koji zaostaje nakon procesa dobivanja maslinovog ulja, a njezin kompleksi kemijski sastav primarno ovisi o tehnologiji mlina, sorti i vremenu berbe. Zbog visokog sadržaja polifenolnih komponenti, uglavnom derivata fenolnih kiselina, flavonoida i sekoiridoida, prepoznata je kao potencijalno važan izvor bioaktivnih komponenti i nutirceutika. U okviru našeg istraživanja ekstrakti komine masline pripremljeni su korištenjem *food-grade* otapala, kombinacijom mikrovalne ekstrakcije i inkapsulacije ciklodekstrinima s ciljem istražitivanja njihove antioksidativne aktivnost u modelima hrane. Korišteni modeli uključivali su ORAC metodu, model mesa (praćenje nastajanja produkata lipidne peroksidacije TBARS metodom), model ulja (rancimat test i određivanje peroksidnog broja) i model emulzije (zaštita β-karotena). Dobiveni rezultati pokazuju da inkapsulacija ciklodekstrinima značajno poboljšava antioksidacijsku učinkovitost primjenjenih ekstrakta (u usporedbi sa neinkapsuliranim ekstraktom), ovisno o vrsti i koncentraciji primijenjenog ciklodekstrina. U tom smislu, najučinkovitijima su se pokazali ekstrakti inkapsulirani nasumično metiliranim ciklodekstrinom (RAMEB) i hidroksipropil-β ciklodekstrinom (HPβ) u koncentracijama 8 g/L. Osobito dobru antioksidacijsku učinkovitost analizirani ekstrakati pokazuju u uljima te emulzijskom modelu, dok je u ostalim modelima hrane njihova antioksidacijska učinkovitost značajno manja u usporedbi sa najčešće korištenim sintetskim antioksidansima (butilhidroksianisolom i Troloxom®).

Ključne riječi: ekstrakt komine masline, antioksidacijska aktivnost, modeli hrane, ciklodekstrin

Keywords: olive pomace extract, antioxidant activity, food models, cyclodextrin

BIOLOGICAL ACTIVITY OF DIFFERENT TYPE OF ELDERBERRY WINE

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oral presentation

Elderberry is one of the oldest and popular medicinal herbs, it has been used in medicinal purposes since prehistoric times. Bioactive components were found in all parts of plant. The objective of this research was to show different biological activity of two types wine from elderberry. Two samples of wine were prepared. The first sample of wine was prepared without the influence of temperature, while the second sample of wine was treated with heat at a temperature 60 °C during 5 minutes. Antioxidant potential of wine was analyzed using several different in vitro antioxidant assays: ABTS (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid), DPPH (2,2-diphenyl-1-picrylhydrazyl), CUPRAC (cupric reducing antioxidant capacity) and phosphomolybdenum assay. Total phenolic, total flavonoid and total anthocyanins content were determined spectrophotometrically and their contents amounted for first sample 66.65±0.70 mg galic acid/g wine, 1.97±0.66 mg rutin/g wine and 27.53±3.48 μg eq c*yanidin-3-glucoside*/mg wine, respectively. Total content of these compounds in second sample of wine was 70.15±0.92 mg galic acid/g wine, 4.30±0.05 mg rutin/g wine and 25.57±0.63 μg eq c*yanidin-3-glucoside*/mg wine, respectivily. Polyphenol profile was performed using the HPLC method, which it was detected 33 compounds in wine without heat treatment and 35 compounds in wine wich was heat treated at a temperature 60° during 5 minutes. Enzyme inhibitory effects were tested against cholinesterase, tyrosinase, amylase and glucosidase. Wine without influence of temperature had better antioxidant potency in all assays (IC_{50} = 6.17 ± 0.42 μg/mL wine for ABTS). The wine treated with heat showed the best enzyme inhibitory activity, according to the enzyme tyrosinase (11.51±0.66 mg KAE/g wine). The results of this study showed a high content of secondary metabolites in the analyzed wine of the elements, and it can be concluded that obtained wine can improve some characteristics, so that it can be used for therapeutic purposes.

Keywords: elderberry, wine, functional food

HERBAL PRODUCTS AS POTENTIAL THERAPY FOR IRRITABLE BOWEL SYNDROME

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oral presentation

Irritable bowel syndrome (IBS) is functional disorder of *gastrointestinal tract* (GIT) characterized by pain and discomfort in the abdomen, inflation or distension of bowel and stool rhythm disorders, from constipation to diarrhea. It affects almost 15% of population, predominantly in women and younger. Pathophysiological it is multifactorial disorder combined of genetic predisposition, GIT disorders, *fecal flora* (FF) disorder and bacterial overgrowth, *visceral hypersensitivity* (VH) disorder and central dysregulation, local inflammation, bile acids and food (hyper) sensitivity. Because IBS is life-long disorder it is necessary to provide education and support in lifestyle changes and high-fiber and FODMAP diet. Current medication recommended therapy is based on antispasmodics, prokinetics, antiafferent drugs, laxatives and antidiarrheal drugs, antidepressants and others such as *otilonum* and *pinaverium*. Medicament therapy shows some doubtful efficacy, and the placebo response rate in IBS is estimated up to 40%. Herbal therapy could be useful, and data suggest that *peppermint oil* is efficacious in IBS for abdominal pain. STW 5 was superior to placebo. Combination of 20 Chinese herbs was superior to placebo in some studies and belladona in others, but other adequate *randomized control trials* (RCT) are needed because the quality of most of these trials was low and we can not exclude publication bias. St. John's wort has also been included in placebo-controlled trials, but show no beneficial effect in IBS.

Keywords: Irritable bowel syndrome, herbal products, potential therapy

***FOOD SAFETY* /**
ZDRAVSTVENA SIGURNOST HRANE

MICROBIOLOGICAL QUALITY OF YOGHURT AND SOUR CREAM IN DAIRY PLANT MILKOS D.D. SARAJEVO

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poster presentation

Microbiological quality of milk is of great importance to human health. Products of questionable quality shuld not be used for human consumption but withdrawn from the market. Thus, a strict control of their quality must be carried out. For the purpose of writing this paper, laboratory findings of microbiological analyses of 475 samples of yoghurt (3.2% of milk fat, quantity of 1 liter), and 298 samples of sour cream (Mileram sour cream 30%, 850 grams and 12%, 850 grams) were used from Milkos d.d. Sarajevo on several ocasions during the years 2015/2016. The products were tested for the following microorganisms: *Salmonella* spp.; coagulase of positive *Staphylococcae*; sulforeduction clostridia; enterobacteria; yeast and mold; *Listeria monocytogenes* and *Escherichia coli*.
Microbiological analysis revealed positive samples for yeasts and molds in the cream of Mileram 30%, 850 grams (155 total number of samples, 5 positive and 150 negative samples) and Mileram 12%, 850 grams (143 total number of samples, 3 positive and 140 negative samples) also on yeast and mold.
Out of the total number of samples (773) eight samples of Mileram sour cream tested positive. Based on the results of microbiological analyzes of yoghurt and sour cream, it was concluded that microbiological quality of yoghurt was in accordance with microbiological guidelines and tested negative for all investigated microorganisms, while a small number of sour cream sampeles tested positive, suggesting that milk is of good microbiological quality. These microbiological analyzes correspond to the Guidelines on Microbiological Criteria for Foodstuff (Official Gazette of BiH No. 11/13, Article 23, Paragraph 1, as well as Article 4).

Keywords: microbiological analysis, milk, HACCP, Milkos d.d.

KEMIJSKA ANALIZA PLODA BRESKVE NA PODRUČJU HERCEGOVINE

CHEMICAL ANALYSIS OF PEACH FRUIT IN HERZEGOVINA

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poster presentation / postersko priopćenje

Cilj rada je bio ispitati utjecaj različitih agroekoloških uvjeta na kemijska svojstva ploda pet sorti breskve na području Hercegovine. Kao materijal za istraživanje poslužili su plodovi breskve sorti Maycrest, Springcrest, Spring Lady, Rich Lady i Elegant Lady uzeti sa lokaliteta: Mostar, Stolac i Čapljina, tijekom tri godine. Od parametara kemijskog sastava analizirani su sadržaj ukupne topljive suhe tvari (%), sadržaj ukupnih šećera (%), sadržaj ukupnih kiselina (%), te indeks zrelosti. Rezultati pokazuju statistički značajne razlike u kemijskom sastavu ploda breskve u zavisnosti od sorte i lokaliteta. Najveći prosječan sadržaj ukupne topljive suhe tvari (12,22 %) izmjeren je kod sorte Elegant Lady (Mostar), a najmanji (11,81 %) kod sorte Maycrest (Čapljina). Statistički značajno veći sadržaj ukupnih šećera (10,25 %) evidentiran je kod sorte Elegant Lady (Stolac), a najmanji kod sorte Rich Lady (9,14 %) na lokalitetu Mostar. Najveći sadržaj ukupnih kiselina (0,77 %) izmjeren je kod sorte Maycrest (Stolac), a najmanji (0,54 %) kod sorte Elegant Lady (Mostar). Najveći indeks zrenja (22,68 %) imala je sorta Elegant Lady (Mostar), a najmanji (15,08 %) sorta Maycrest u Stocu. Može se zaključiti da se ispitivane sorte na sva tri lokaliteta odlikuju odličnom kvalitetom ploda u pogledu kemijskog sastava, te se mogu preporučiti farmerima za širenje u Hercegovini.

Ključne riječi: breskva, suha tvar, šećeri, kiseline

Keywords: peach, dry matter, sugars, acids

REZULTATI MONITORINGA OSTATAKA PESTICIDA U I NA HRANI BILJNOG PODRIJETLA NA TRŽIŠTU BOSNE I HERCEGOVINE U 2017.

RESULTS MONITORING OF PESTICIDE RESIDUES IN OR ON FOOD OF PLANT ORIGIN IN BOSNIA AND HERZEGOVINA IN 2017

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oral presentation / usmeno priopćenje

Monitoring ostataka pesticida u i na hrani ima za cilj utvrditi količinu ostataka pesticida i njihovih metabolita u odabranim proizvodima, provjeriti odgovaraju li propisima koji određuju maksimalne razine ostataka (MRL) pesticida i pridržavaju li se proizvođači načela dobre poljoprivredne prakse (GAP) te na taj način doprinijeti zaštititi zdravlje potrošača. U okviru monitoringa ostataka pesticida u 2017. godini ukupno je uzorkovano 195 uzoraka hrane biljnog porijekla na 213 različitih aktivnih tvari te je provedeno 31486 analiza. Od ukupno uzetih 195 uzoraka, 105 uzoraka je voća, 70 uzoraka povrća i 20 uzoraka ostalih kategorija hrane (voćne kaše za djecu na bazi povrća, pšenica u zrnu/brašno pšenično i kultivirane gljive). Na osnovu obrađenih laboratorijskih izvješća utvrđeno je da od ukupnog broja uzorkovanih i analiziranih uzoraka kod četiri uzorka (2 %) je utvrđena vrijednost ostataka pesticida iznad maksimalno dozvoljene propisane količine i to kod jednog uzorka kultiviranih gljiva, dva uzorka stolnog grožđa i jednog uzorka šljive. Od ukupnog broja analiziranih uzoraka kod 60 uzoraka (31 %) su detektirani ostaci pesticida ispod propisane maksimalno dozvoljene količine, dok je kod 131 uzorka (67 %) ostaci pesticida nisu detektirani. Ostaci pesticida nisu nađeni kod voćne kaše, suhog graha, krastavca kornišona, krumpira, mandarina i mladog luka.

Ključne riječi: pesticidi, monitoring, maksimalni nivo ostataka pesticida, voće i povrće

Keywords: pesticides, monitoring, maximum level of pesticide residues, fruits and vegatables

POLYCYCLIC AROMATIC HYDROCARBONS IN SELECTED FOOD FROM CROATIAN MARKET

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oral presentation

The study aims to evaluate the presence of 15 polycyclic aromatic hydrocarbons (15 PAHs) listed as priorities for determination in food and environment by US Environmental Protection Agency (US-EPA) in fishery products, shellfish, meat products and spices. A total of 140 samples were investigated during the period of one year by ultra pressure liquid chromatography. Total mean amount of PAHs compounds ranged from initial 5.53 µg/kg (mussels) to maximal 224.59 µg/kg (spices). PAHs composition pattern was dominated by the presence of light PAHs from 69.6% in shellfish to 98.3% in dry fermented sausages. The percentage of PAH8 defined by both European Commission (EC) and US-EPA list in total PAHs varied between 2.44% in dry fermented sausages and 36.61% in shellfish. In most analyzed samples the benzo(a)pyrene (B[a]P) was detected in the mean ranges per food group from 0.11 µg/kg (mussels) to 4.41 µg/kg (spices). None of the samples groups exceed the currently acceptable concentration of (B[a]P) and ∑PAH4 set by European legislation. The highest BaP (21.56 µg/kg) and ∑PAH4 (112.97 µg/kg) levels have been confirmed in smoked paprika. Superior benzo(a)pyrene equivalents (BaPE) calculated to PAH8 were reported for spices (45.35 µg/kg) followed by other shellfish (2.84 µg/kg), smoked fish (1.58 µg/kg) and dry fermented sausages (0.90 µg/kg).

Keywords: polycyclic aromatic hydrocarbons, food, spices

ANTIMICROBAL ACTIVITY OF PLANT EXTRACTS FROM GENUS *Allium*

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poster presentation

The subject of this study was to investigate the antimicrobial potential of methanolic extracts of plants from the genus *Allium*: ramsons - *Allium ursinum L.*, garlic - *Allium sativum* L. and red onion - *Allium cepa* L.. The antimicrobial effect of the investigated extracts was studied using a disc dilution method. In this way, we tried to inhibit the growth of all bacteria and especially *Salmonella sp*., isolated from the regular food control sample, which is part of the monitoring of the health safety of finished products before placing them on the market.
The extracts showed a visible zone of inhibition on the nutrient surface for the total number of microorganisms (Plate Count Agar) in which the bacterial growth was prevented. The *A. sativum* extract had the most expressed inhibition zone of 27.91 mm, followed by *A. ursinum* (21.13 mm), and the lowest antimicrobial activity was detected for *A. cepa* (15.24 mm). The antimicrobial activity of investigated extracts was significantly weaker against *Salmonella spp. A. ursinum* showed an inhibition zone with a diameter of 14.73 mm, and *A. sativum*. showed an approximate value of 14.11 mm, while extracts of *A. cepa* did not show any antimicrobial activity against *Salmonella spp.*

Keywords: *Allium ursinum* L., *Allium sativum* L., *Allium cepa* L., *Salmonella spp.*, disc dilution method, antimicrobial acitivty

UTJECAJ TEHNOLOŠKE OBRADE I NIVOA DODANIH POLIFOSFATA (P_2O_5) NA SPOSOBNOST VEZIVANJA VODE DIMLJENIH PILEĆIH PRSA

THE INFLUENCE OF TECHNOLOGICAL PROCESS AND LEVEL OF ADDED POLYPHOSPHATE (P_2O_5) ON WATER HOLDING CAPACITY OF THE SMOKED CHICKEN BREASTS

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poster presentation / postersko priopćenje

Polifosfati (P_2O_5), uz nitrite i nitrate, su najčešće korišteni aditivi u mesno-prerađivačkoj industriji. Koriste se u svrhu emulgiranja, a omogućuju homogeno miješanje ulja i masti s vodom ili vode s uljima i mastima, kao i drugim sastojcima, pri čemu stvaraju stabilne emulzije. Prema važećem Pravilniku (BiH), nivo polifosfata u termički obrađenim mesnim proizvodima ne smije biti veći od 5000 mg/kg. Uz sposobnost emulgiranja, polifosfati potiču i vezivanje vode u mesnom proizvodu. Ipak, prevelike količine fosfora u gotovom proizvodu mogu utjecati na zdravstvenu ispravnost i sigurnost proizvoda.
Cilj istraživanja je bio utvrditi da li, i u kolikoj mjeri, sadržaj dodatih polifosfata utječe na sposobnost vezivanja vode u gotovom proizvodu. Ovo tehnološko svojstvo je određeno temeljem dobivenih parametara za gubitak (kalo) mase tijekom termičke obrade dimljenih pilećih prsa.
U istraživanju su korištene dvije skupine uzoraka. Kod prve skupine, uzorci su injektirani salamurom, a kod druge su korišteni masažeri (tambleri). Svaka skupina je podijeljena na tri podskupine. U prvoj podskupini uzorcima nisu dodavani polifosfati, u drugoj je njihov sadržaj smanjen za 50 %, a u trećoj je korištena standardna količina polifosfata (P_2O_5).
Istraživanjem je utvrđen najmanji gubitak (kalo) mase tijekom termičke obrade kod uzoraka sa standardnom količinom dodatih polifosfata kod obje skupine, u iznosu od 21,72 % (prva skupina) i 21,66 % (druga skupina). Dobiveni rezultati istraživanja ukazuju na opravdano korištenje polifosfata u svrhu vezivanja vode tijekom proizvodnje dimljenih pilećih prsa.

Ključne riječi: tehnologija, pileća prsa, polifosfati (P_2O_5), vezivanje vode

Keywords: technology, chicken breast, polyphosphate (P_2O_5), water holding

UTJECAJ MEDA *Satureja subspicata Vis*. NA KOROZIJU KOSITRA I ŽELJEZA U KISELOM MEDIJU

IMPACT OF *Satureja subspicata Vis.* HONEY ON CORROSION OF TIN AND IRON IN ACIDIC MEDIA

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poster presentation / postersko priopćenje

Ambalaža od bijelog lima (željezo presvučeno kositrom) koristi se u prehrambenoj industriji za čuvanje hrane. U kiselom mediju podložna je koroziji, a korozijski produkti štetno djeluju na zdravstvenu ispravnost hrane.
U ovom radu ispitivan je utjecaj meda *Satureja subspicata Vis*. na koroziju kositra i željeza u kiseloj (pH = 3,0) 3 %-tnoj otopini natrijevog klorida, bez i uz prisutstvo različitih količina meda. Prethodna istraživanja ukazuju da prefenat derivati, osobito fenilalanin i metil-siringat, dominiraju u *Satureja subspicata* Vis. medu, a ekstrakti meda pokazali su snažnije antioksidacijsko djelovanje u odnosu na sam med.
Korozijska ispitivanja provedena su dvjema nedestruktivnim metodama: metodom elektrokemijske impedancijske spektroskopije (EIS) i metodom linearne polarizacije. Rezultati dobiveni elektrokemijskom impedancijskom spektroskopijom modelirani su ekvivalentnim električkim krugom s dvije vremenske konstante te su određene vrijednosti polarizacijskog otpora. Polarizacijski otpor određen je i iz rezultata dobivenih linearnom polarizacijom. Vrijednosti polarizacijskog otpora određene ovim različitim metodama pokazuju međusobno dobro slaganje te je iz njih izračunat stupanj djelotvornosti meda kao inhibitora korozije kositra i željeza.

Ključne riječi: kositar, željezo, med, korozija, kiseli medij

Keywords: tin, iron, honey, corrosion, acid media

INHIBITION OF ALUMINIUM ALLOY CORROSION IN CHLORIDE SOLUTION BY CAFFEINE ISOLATED FROM BLACK TEA

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Caffeine (1,3,7-trimethylxanthine) was isolated from black tea and characterised using different physical methods. The corrosion inhibition performance of the caffeine isolate (in concentration from 1×10^{-5} to 1×10^{-3} mol dm^{-3}) on aluminium alloy corrosion in neutral 0.5 mol dm^{-3} NaCl solution was investigated using potentiodynamic and linear polarization measurements at 20 °C. Corrosion potential, corrosion current and polarization resistance were determined and surface coverage of inhibitor molecules and inhibition efficacy were calculated. The obtained results show that caffeine effectively inhibited the corrosion reaction in the chloride solution with an inhibition efficiency of up to ≈76%. Furthermore, caffeine was found to function essentially as a mixed type with a higher influence on cathodic reaction. The adsorption behaviour of investigated inhibitor can be described by the Frundlich adsorption isotherm. The adsorption free energy closes to – 10 kJ mol^{-1} indicates physical adsorption of the caffeine on the aluminium alloy surface in NaCl solution.

Keywords: aluminium alloy, corrosion, inhibition, caffeine

PRISUTNOST BAKTERIJSKE VRSTE *Staphylococcus aureus* U MESU PERADI

THE PRESENCE OF BACTERIAL SPECIES *Staphylococcus aureus* IN POULTRY MEAT

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poster presentation / postersko priopćenje

Bakterijska vrsta *Staphylococcus aureus* široko je rasprostranjena u prirodi i dio je fiziološke mikroflore 10-20 % ljudi, mnogih vrsta sisavaca i ptica. U ljudi uzrokuje niz bolesti od benignih kožnih infekcija do teških, za život opasnih infekcija koje se očituju apscesima, osteomijelitisom, pneumonijom, endokarditisom i sepsom. Bakterija tvori specifične čimbenike virulencije kao što su enzimi, egzotoksini i enterotoksini (SEs) koji joj omogućavaju prodor u organizam i uzrokovanje bolesti. Zastupljenost različitih stafilokoknih enterotoksina koje bakterija stvara te razvoj mehanizma rezistencije na antibiotike koji se koriste u liječenju stafilokoknih infekcija vrlo je važan klinički i epidemiološki problem. Enterotoksini su termostabilni i otporni na djelovanje proteolitičkih enzima, a neki od njih uzrokuju alimentarne intoksikacije u ljudi.
Tijekom 2017. godine pretraženo je 257 uzoraka mesa peradi (sirovo meso trupova) prema kriterijima navedenim u Vodiču za mikrobiološke kriterije za hranu (ožujak, 2011.). Nalaz bakterijske vrste *S. aureus* u 29 (11,3 %) uzoraka nije udovoljavao navedenom kriteriju u Vodiču. Osim stafilokoka, uzorci su pretraženi još na slijedeće parametre: *Salmonella* spp., *Listeria monocytogenes*, *Enterobacteriaceae,* sulfitreducirajuće klostridije i aerobne mezofilne bakterije. U tri (1,2 %) uzorka dokazane su bakterije iz roda *Salmonella*.

Ključne riječi: *Staphylococcus aureus*, meso, perad

Keywords: *Staphylococcus aureus*, meat, poultry

KARAKTERIZACIJA PJENASTOG POLISTIRENA NAKON OPORABE ORGANSKIM OTAPALOM LIMONENOM

CHARACTERIZATION OF THE EXPANDED POLYSTYRENE FOAMS AFTER RECOVERY USING LIMONENE AS ORGANIC SOLVENT

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Polistiren (PS) je plastomer linearnih makromolekula, a dobiva se procesima polimerizacije stirena. Odlikuje ga raznolikost primjene, lagano prerađivanje, relativno niska cijena, pa se proizvodi u ogromnim količinama i spada u tzv. široko primjenjive plastomere. Pjenasti polistiren nazvan i celularni ili ekspandirani polistiren (PS-E) je plastomerni materijal ćelijaste strukture i niske gustoće. Zahvaljujući strukturnim svojstvima PS-E pripada u najčvršće ćelijaste materijale, odličnih svojstava zvučne i toplinske izolacije, vrlo male apsorpcije vode i male propusnosti vodene pare. PS-E se najviše primjenjuje u građevinarstvu, a zatim za izradu ambalažnih materijala za hranu, elektroničku opremu, kemikalije, farmaceutske proizvode, izolaciji rashladnih uređaja i slično. Shodno tome, široka upotreba PS-E-a ujedno predstavlja i veliki problem zagađenja okoliša. Razvijeni su brojni postupci oporabe stiropora, među kojima se ističe postupak otapanja u biorazgradljivom organskom otapalu d-limonenu. U ovom radu izvršena je izolacija limonena iz kore naranči te njegova primjena kao ekološki prihvatljivog otapala u postupku oporabe pjenastog polistirena. Zaostali limonen prilikom oporabe uklonjen je postupkom precipitacije neotapalom. Karakterizacija PS-E-a nakon oporabe precipitacijom provedena je primjenom infracrvene spektroskopije i diferencijalne pretražne kalorimetrije. Rezultati analize pokazali su da precipitacija neotapalom nije dobra metoda za uklanjanje limonena iz oporabljenog pjenastog polistirena.

Ključne riječi: pjenasti polistiren, ambalaža, oporaba, limonen

Keywords: expanded polystyrene, packaging, recovery, limonene

ODREĐIVANJE SADRŽAJA HISTAMINA U RIBI I PROIZVODIMA OD RIBE PRIMJENOM METODE ELISA

DETERMINATION OF HISTAMINE IN FISH AND FISH PRODUCTS USING THE METHOD OF ELISA

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poster presentation / postersko priopćenje

Standardi sigurnosti hrane zahtijevaju detekciju spojeva koji i u tragovima mogu utjecati na zdravlje ljudi, kao što su biogeni amini. Histamin je jedan od najproučavanijih biogenih amina, ponajprije zbog svoje toksičnosti, a prema nekim autorima izdržava temperaturu od čak 200 °C, što znači da ga temperature sterilizacije ne mogu uništiti. Za određivanje sadržaja histamina u ribi i proizvodima od ribe korištena je enzimsko-imunokemijska metoda (ELISA). ELISA je selektivna i osjetljiva metoda, a softver koji prati uređaj omogućava jednostavnu i brzu interpretaciju dobivenih rezultata, kao mogućnost istovremenog ispitivanja većeg broja uzoraka.
U radu je određen sadržaj histamina u dvije grupe uzoraka: prva grupa je bila konzervirana morska riba iz dvije tvrtke s područja Hercegovine, Hercegovačko-Neretvanskog kantona, i ona je predstavljala gotov proizvod od ribe; a druga grupa bila je svježa slatkovodna riba (pastrva) iz ribnjaka sa područja FBiH (5 ribnjaka). Ukupno je ispitano 60 uzoraka (30 proizvoda od ribe i 30 slatkovodnih riba) i nije utvrđeno prisustvo histamina.

Ključne riječi: ELISA, sadržaj histamina, riba, proizvodi od ribe

Keywords: ELISA, histamine content, fish, fish products

MICROBIOLOGICAL ANALYSIS AND DETERMINATION OF QUALITY OF WATER

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oral presentation

People are daily exposed to various factors that affect their health. Among these factors is certainly the influence of the environment, especially the influence of hygienically inadequate water that a person consumes on a daily basis. Contaminated water can be the source of many, especially intestinal diseases, and there is no water that is sterile, except in the pharmaceutical industry. So, naturally in the water there are many microorganisms, minerals, and many other components that make it such - the basic fluid of life. In this regard, many components of water in certain concentrations can have a disastrous effect on the health of the population.
The aim of this paper was the determination of water quality, which was carried out through the analysis of microbiological indicators of water quality in the Municipality of Kakanj (Zenica-Doboj Canton, Bosnia and Herzegovina). Eight sources from different locations were analyzed in order to determine the quality parameters of the water. During the study, turbidity, nitrites, nitrates, sulfides, sulphates, phosphorus and calcium were analyzed, parameters whose permitted values in water were determined by the Regulation on health safety of drinking water. Using the HACH 2000 spectrophotometer and titration with EDTA solution, performed chemical analysis together with the microbiological make a complete analysis of the water quality.
In the sixteen tested samples, we did not find higher concentrations of the declared unallowed components. Finally, in terms of the parameters that were analyzed, we can conclude that all tested sources correspond to the criteria of B&H Regulations on sanitary water and that are safe for consumption.

Keywords: water, mikcrobiology, analysis, quality, Kakanj

REDUKCIJA T-2 I HT-2 TOKSINA U ZOBENOM BRAŠNU PRIMJENOM NISKOTLAČNE DBD DUŠIKOVE PLAZME

REDUCTION OF T-2 AND HT-2 TOXINS IN OAT FLOUR WITH LOW PRESSURE DBD NITROGEN PLASMA

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poster presentation / postersko priopćenje

Mikotoksini se zbog svoje kompleksne strukture i visoke stabilnosti vrlo teško uklanjaju iz prehrambenog lanca čime predstavljaju ozbiljnu prijetnju ljudskom zdravlju. T-2 toksin i njegov glavni metabolit HT-2 predstavljaju trihotecenske mikotoksine izrazite toksičnosti za koje je dostupno vrlo malo podataka o učincima prerade hrane na njihovu prisutnost. Primjena tehnologije obrade namirnica hladnom plazmom kao nove ne toplinske metode u prehrambenoj industriji pokazala se kao učinkovita metoda u širokom spektru proizvodnih faza. Za sada malobrojna istraživanja ukazuju na potencijal hladne plazme u uklanjanju mikotoksina, pri čemu vrsta hrane i mikotoksina utječu na učinkovitost ove metode. Cilj ovog rada je ispitivanje utjecaja niskotlačne DBD hladne plazme s dušikom kao radnim plinom na učinkovitost redukcije T-2 i HT-2 toksina u uzorku zobenog brašna pri vremenima izlaganja uzorka od 10, 20 i 30 minuta. Koncentracija T-2 i HT-2 toksina prije i nakon tretmana hladnom plazmom određena je primjenom tekućinske kromatografije s masenom spektrometrijom (LC-MS/MS). Rezultati pokazuju da je uklanjanje T-2 i HT-2 toksina ovisno o trajanju tretmana hladnom plazmom, a maksimalna redukcija (38.6%) postiže se nakon 30 minuta izlaganja. Dobiveni rezultati pokazuju učinkovitost hladne plazme u uklanjanju T-2 i HT-2 toksina, s konačnim ciljem sigurnosti hrane i zaštite zdravlja ljudi i životinja.

Ključne riječi: mikotoksini, hladna plazma, T-2 toksin, HT-2 toksin, redukcija

Keywords: mycotoxins, cold plasma, T-2 toxin, HT-2 toxin, reduction

THE ROLE OF CELLULAR MECHANISM IN *Campylobacter jejuni* ADHERENCE

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oral presentation

Campylobacter jejuni is the most prevalent cause of bacterial gastroenteritis worldwide and it represents a significant public health risk as a foodborne pathogen. Although susceptible to a wide variety of food processing and environmental stresses, it is also increasingly resistant to changing environments and to antimicrobials. Beside new antimicrobials targeting bacterial growth new strategies targeting other bacterial properties are needed to control this pathogen and ensure food safety. *Campylobacter* has no adjustment mechanisms that allow immediate cellular responses. Therefore, we investigate the mechanisms responsible for resistance and cellular defense with mutants in efflux pump (*cmeB*); intracellular signaling (*luxS*); membranous capsular proteins (*kpsM, omp50*); flagellin (*Cj1324*); and bacterial general stress responses (*spoT*). We examine the growth curves, adhesion/biofilm formation on polystyrene model surface, bacterial communication, motility and aggregation. Using this knowledge, we will expose the mechanisms which target *Campylobacter* adhesion and propose a strategy to reduce *Campylobacter* contamination under the conditions used in the food chain, and consequently reduce the antimicrobial resistance in raw materials and food products. We will present efflux system-fitness correlation and introduce alternative compounds of natural origin that are effective against both antibiotics susceptible/resistant *Campylobacter* with great promise for practical applications to ensure food safety.

Keywords: *Campylobacter jejuni*, adhesion, cellular mechanism, natural compounds, alternative control strategy

STAVOVI I ZNANJA POTROŠAČA PREMA KVALITETI I SIGURNOSTI HRANE NA PODRUČJU FBIH

ATTITUDES AND KNOWLEDGE OF CONSUMERS ACCORDING TO QUALITY AND SAFETY FOOD IN FB&H

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Provjerena kvaliteta i sigurnost hrane jedan je od najznačajnijih elemenata koji utječe na stvaranje pozitivne slike potrošača o proizvodu. Cilj rada je bio ispitati znanja, stavove i praksu potrošača u odnosu na kvalitetu i sigurnost dostupnih proizvoda. U istraživanje je bilo uključeno 1568 ispitanika iz četiri dobne skupine na području FBiH, koje je provedeno u 2017. godini. Kao instrument mjerenja korišten je anonimni anketni upitnik koji se sastojao od 17 pitanja (3 pitanja su se odnosila na opće informacije: dob, spol i stručna sprema, dok se 14 pitanja odnosilo na znanja i stavove potrošača o kvaliteti i sigurnosti hrane).
Na pitanje šta predstavlja najveću opasnost za zdravlje potrošača najveći udio ispitanika iz ruralne sredine smatra da je to hrana nakon isteka roka 388 (67,71 %), dok isto smatra 480 (48,24 %) iz urbane sredine. Ispitanici iz obje životne sredine bi imali više povjerenja u proizvode koji nose oznaku kvalitete mreže nezavisnih laboratorija u regiji, i to 585 (58,79 %) ispitanika iz urbane sredine te 325 (56,72 %) ispitanika iz ruralne sredine. Postoji značajna statistička razlika u stavu potrošača prema dokazu o kvaliteti proizvoda u odnosu na pojedine dobne skupine.
Zaključak je da bi potvrda kvalitete proizvoda od nezavisnih laboratorija podigla razinu povjerenja potrošača u pojedine proizvode.

Ključne riječi: potrošači, kvaliteta hrane, sigurnost hrane, stavovi potrošača

Keywords: consumers, food quality, food safety, consumer attitudes

A COMPARATIVE SURVEY ON THE PREVALENCE OF PARASITE ELEMENTS IN FRESH VEGETABLES AND READY-TO-EAT SALADS

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poster presentation

While highly nutritional, raw vegetables pose a significant health risk of food-borne diseases. Along with their popularity among the consumers, the number of food recalls for ready-to-eat salads around the world is constantly increasing. The study focused on the prevalence of parasite elements in vegetables, selected randomly from two fresh food markets and two retail supermarkets from the area of Osijek city between March and June 2018. Four types of vegetables lettuce (*Lactuca sativa*), cabbage (*Brassica oleracea* var. *capitata*), kale (*Brassica oleracea* var. *acephala*) and spinach (*Spinacia oleracea*)) and ready-to-eat salads (combinations of carrot, different types of lettuce, cabbage, and beetroot) have been analysed. Total of 26 samples from fresh food markets and 11 ready-to-eat salads were analysed by light microscopy. Parasite elements were detected in 5.41% of all tested samples. The 9.1% of lettuce and ready-to-eat salads samples contained undefined cysts. The highest increase in detected number of parasitic elements was observed in June. All other types of vegetables analysed were free from parasitic elements. Ready-to-eat salads pose significant health risk for the consumer, underlying the need for more promotional activities to increase consumer's awareness of the potential risks related to consumption of ready-to-eat salads.

Keywords: ready-to-eat salads, fresh vegetables, parasite elements, fresh food markets, retail supermarkets

THE CLINOPTILOLITE SURFACE AFFECTS FORMATION OF CRYSTALS FROM THE CLINOPTILOLITE PRE-TREATED WATER

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Zeolite clinoptilolite is a natural mineral of volcanic origin acknowledged as a non-toxic material to mammals. Due to its crystalline structure with pores and cavities, it is an ion-exchanger that may be useful for certain detoxification purposes *in vivo*, as proven by a series of studies as well. This and other biological effects *in vivo* are most probably related to physical-chemical structure of certain clinoptilolite materials, especially its surface. We therefore, present herein the study of the different clinoptilolite materials surface by a simple approach of monitoring the crystal formation from the water pre-treated with clinoptilolite materials subjected to different production processes. These materials contain different fractions of particles, that also influence formation of crystals form the certain fractions' pre-treated water. Interestingly, the largest percentage of crystals formed from zeolite clinoptilolite pre-treated water were Silicon and Oxygen-containing crystals. Therefore, we assume that the clinoptilolite pre-treated water contains colloidal silica in the polymerized form or soluble ortosilicic acid. The ortosilicic acid is a weak acid with silicon tetrahedrally coordinated to four hydroxyl groups. Such structure can bind positively charged cations such as for example the trivalent cation aluminum which may be relevant for its elimination *in vivo* as well.

Keywords: Zeolites, clinoptilolite, ortho-silicic acid, detoxification, clinoptilolite surface

GREEN SYNTHESIS OF SILVER NANOPARTICLES AND THEIR ANTIMICROBIAL ACTIVITY

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poster presentation

Nanotechnology can be an important part of the future agriculture and food industry by applying (bio)synthesized nanoparticles to the different crops. They enter into plants through cuticle, stomata, stigma, root tips, cortex, lateral root junction and wounding, thus preventing the membrane damage and stress tolerance. This paper represents an overview of green synthesis of sliver nanoparticles and their antimicrobial activity. The synthesis was carried out in two different experiments, using the apple and banana extract. The source of silver, in both experiments, was silver nitrate ($AgNO_3$), while the extract was used as both, reducing and stabilizing agent of the solution. The quantitative analysis and maximum absorbance of synthesized nanoparticles was implemented utilizing the method of spectrophotometry. In order to determine inhibitory effects of silver nanoparticles, the test diffusion antibiogram method was used, based on the antibiotic diffusion through the nutrient-rich agar, previously sieved by the particular bacterial cultures, which in this case were *Staphylococcus aureus, Enterococcus* and *Escherichia coli*.

Keywords: apple and banana extract, *Staphylococcus aureus, Enterococcus, Escherichia coli,* test diffusion method

THE EFFECT OF THERMAL PROCESSING ON THE REDUCTION OF MAIZE FUMONISIN CONTENT

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poster presentation

Fumonisins are naturally occurred *Fusarium* mycotoxins, which mainly contaminate maize and its by-products, especially during heavy rainy periods and in case of substantial temperature changes during the maize growth and harvesting period. The combination of processing time and temperature applied during thermal processing of cereals remains one of the most important methodologies through which industrial processing can reduce mycotoxin content. In order to establish the effect of thermal processing on the total fumonisin content in naturally contaminated maize, this study made use of cooking, roasting and extrusion cooking, run at different temperatures (100 – 220 °C) for a different length of time (10 – 30 min). Before and after treatment, contaminated maize samples were analysed for fumonisin content using a validated enzyme-linked immunosorbent assay (ELISA). In comparison with cooking, which yielded a negligible mean fumonisin content reduction (up to 5%), roasting and extrusion resulted in a significantly higher fumonisins' reduction (by 62% and 96%, respectively). A significantly higher ($p < 0.05$) and almost complete fumonisins' reduction was achieved with extrusion at the highest temperature regime (135/190/190 °C - dosing/compression/ejection zone of extruder). The results show that roasting and especially extrusion are effective and valuable methods able to significantly reduce maize fumonisin content.

Keywords: fumonisins, *Fusarium* mycotoxins, reduction, thermal processing, maize

MICROBIOLOGICAL SAFETY OF FRESH SALAD (*Lactuca sativa* L.)

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poster presentation

The microbiological saffety of 15 samples of fresh salad (*Lactuca sativa* L.) purchased at two different locations in the city of Sarajevo, Markale and Otoka were analysed. Sampling swabs were performed at the beginning of May 2017 to the total number of 160 swabs. Swabs for microbiological analysis were taken from samples of fresh salad in two independent repetitions before and after washing in tap water for 10 minutes. Microbiological tests were performed on the total number of aerobic mesophilic bacteria, the total number of yeast and mold, enterobacteria, *E. coli* and *Salmonella* according to the Rulebook on performing microbiological analyzes (Official Gazette of BiH No. 11/13) and according to the Rulebook on microbiological criteria for foodstuffs (Official Gazette of BiH No. 11/13). The average value of total aerobic mesophilic bacteria in case of unwashed specimens ranged from 0.11 - 0.41 CFU/mL, in the case of washed samples of 0.07 - 0.35 CFU/mL, and soda treated samples 0.01 - 0.11 CFU/mL.

Keywords: microbiological saffety, swabs, *Lactuca sativa* L. (salad)

ANTIMICROBIAL ACTIVITY OF PLANTS EXTRACTS AGAINST SELECTED FOOD BORNE PATHOGENS

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poster presentation

Food-borne pathogens are causing major public health problems worldwide what in recent years have escalated to unprecedented levels. Accordingly, demand for safe and high-quality food has increased. The use and safety of synthetic preservatives is well known but still questionable, what encouraged scientists to search for natural antimicrobial preservatives.
The present research was conducted in order to study the antimicrobial properties of selected medicinal plants against commonly food borne pathogens. Four plant species (lavender- L, rosemary- R, oregano- O and lemon balm- LB) were investigated to evaluate their antibacterial activity against three gram positive (G+) (*Staphylococcus aureus*, *Enterococcus feacalis*, *Listeria monocytogenes*) and two gram negative (G-) bacterial strains (*Salmonella enterica, Escherichia coli*). Plant extracts have been prepared using ultrasound bath (2 h, 60 °C, plant material:water = 15:100). The antibacterial activity was quantified using well diffusion and broth microdilution methods by detection of the inhibition zone and minimal inhibitory concentrations (MICs), respectively.
The analyses of antibacterial activities showed better activity of plant extracts against G+ species and the most effective, with the lowest MIC values (range from 217 to 707 mg GAE/L), were R and O, while the weakest antibacterial activity was observed for LB (>5551.2 mg GAE/L). On contrary, LB and O showed larger inhibition zone (30 mm) using well diffusion method against G+ species. Using both methods all tested plant extracts showed weaker activity, high MIC values and no or small inhibition zone against G- bacterials.

Keywords: plant extracts, MIC, zone inhibition, phenolics

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ULOGA AMBALAŽE U OSIGURAVANJU ZDRAVSTVENE ISPRAVNOSTI HRANE

THE ROLE OF PACKAGING IN FOOD SAFETY

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oral presentation / usmeno priopćenje

Da bi se hrana zaštitila i na siguran način transportirala, skladištila i dostavila krajnjem korisniku treba je staviti u odgovarajuću ambalažu koja ju štiti od mehaničkih, klimatoloških, kemijskih i mikrobioloških utjecaja. Ambalaža aktivno sudjeluje i u prodaji robe. Ona svojim oblikom, teksturom, grafičkim rješenjem i identifikacijom komunicira s potrošačem. Osim toga ona mora omogućiti jednostavnu i udobnu uporabu a istodobno biti atraktivna i suvremena. Ambalaža mora biti prilagođena kupovnoj moći potrošača, njihovoj potrošačkoj kulturi i navikama i mora biti usklađena sa standardima i propisima. Pri kreiranju ambalaže potrebno je tako odabrati elemente oblikovanja ambalaže (ambalažni materijal, prostorni oblik ambalaže, elemente grafičkog oblikovanja) i međusobno ih uskladiti kako bi ambalaža na optimalan način ispunila sve svoje funkcije. Suvremena dostignuća na polju ambalaže (novi ambalažni materijali i oblici i nove tehnike pakiranja), promjene u načinu života stanovništva (urbanizacija, razvoj prometa, nove higijenske i zdravstvene navike itd.) i povećana kupovna moć potrošača (potražnja za kvalitetnijom robom u boljoj, atraktivnijoj i skupljoj ambalaži) razlozi su za sve većom proizvodnjom i potrošnjom ambalaže. Razvoj tehnologije znatno utječe i na ambalažnu industriju. Uporaba biorazgradljivih materijala i materijala modificiranih nanočesticama, razvoj aktivne i inteligentne ambalaže te uporaba sustava za sljedivost proizvoda najznačajniji su trendovi u razvoju ambalaže koja može jamčiti sigurnost i zdravstvenu ispravnost hrane.

Ključne riječi: ambalaža, ambalažni materijali, sigurnost hrane

Keywords: packaging, packaging materials, food safety

FOOD ANALYSIS /
ANALIZA HRANE

UTJECAJ PROCESIRANJA NA ANTIOKSIDATIVNU AKTIVNOST I SADRŽAJ UKUPNIH FENOLA I FLAVONOIDA U BLITVI (*Beta vulgaris* L.*, sbsp. vulgaris*)

EFFECT OF PROCESSING ON ANTIOXIDANT ACTIVITY AND TOTAL PHENOLS AND FLAVONOIDS CONTENTS IN CHARD (*Beta vulgaris* L.*, sbsp. vulgaris*)

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poster presentation / postersko priopćenje

Cilj ovog istraživanja je procijeniti utjecaj procesiranja na antioksidativnu aktivnost i sadržaj ukupnih fenola i flavonoida u blitvi: domaća (n=5) i s tržnice (n=5). Praćen je utjecaj mikrovalnog zagrijavanja i zamrzavanja na sadržaj ispitivanih parametara, uz ekstrakciju u vodi i 30 % etanolu. Ukupni fenoli su određeni uz Folin-Ciocalteu reagens, antioksidativna aktivnost uz FRAP, a kao standard je upotrijebljena galna kiselina. Za flavonoide je upotrijebljen katehin kao standard, a primijenjena je metoda stvaranja kompleksa s $AlCl_3$. Najveći prosječni sadržaj fenola je zabilježen kod uzoraka domaće zamrznute blitve u etanolnom ekstraktu (161,74 ± 5,23 mg GAE/100 g), a najmanji u vodenom ekstraktu svježe blitve s tržnice (112,95 ± 22,09 mg GAE/100 g). Najveći prosječni sadržaj flavonoida je vodenom ekstraktu domaće zamrznute blitve (313,61 ± 2,25 mg CE/100 g), a najmanji kod blitve s tržnice u etanolnom ekstraktu (165,34 ± 26,18 mg CE/100 g).Najveća antioksidativna aktivnost je zabilježena u etanolnom ekstraktu domaćih uzoraka blitve tretiranim mikrovalovima: 139,95 ± 28,31 mg GAE/100 g. Zaključeno je da je nakon mikrovalnog tretiranja uzoraka došlo do blagog povećanja flavonoida i antioksidativne aktivnosti u odnosu na svježe uzorke. Zamrzavanje je uzrokovalo blago povećanje sadržaja fenola i flavonoida, te smanjenje antioksidativne aktivnosti, pri čemu je utvrđena statistički značajna razlika pri nivou značajnosti od 95 %. Svi analizirani parametri su dominirali u blitvi iz domaćinstva u odnosu na blitvu s tržnice.

Ključne riječi: blitva, fenoli, flavonoidi, antioksidativna aktivnost

Keywords: chard, phenols, flavonoids, antioxidant activity

EFFECT OF EXTRUSION PARAMETERS ON SELECTED PROPERTIES OF WHEAT AND HULLESS BARLEY EXTRUDED FLOUR

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poster presentation

Wheat flours, Kraljica and Olimpija, and hulless barley flours, Mandatar and Osvit, were extruded in a single screw extruder at 25, 30 and 35% moisture level and extrusion die head temperature of 90, 100 and 110 °C. The effects of extrusion conditions on water absorption (WAI) and solubility (WSI) indices, and colour parameters were determined. The extrusion process significantly increased water absorption of flours, with the highest values of WAI obtained at higher moisture content and higher die head temperature. The higher moisture content led to the higher values of WSI for both wheats with the highest values obtained at 35% moisture content and 110 °C. Both barley extruded flours showed minor decreases in WSI compared to the native flours, with higher WSI values for the higher moisture content. All colour parameters were significantly affected by the extrusion process. The total colour change parameter (ΔE) had the lowest values for flours extruded at lowest moisture contents, which increased with increasing the moisture content. The results suggest that extrusion of wheat and barley flours allows modifying flour features and might be an alternative to obtain flours with different functionality, depending on the extrusion conditions.

Keywords: cereal flour, extrusion, water absorption, solubility, colour

Acknowledgment
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EXTRACTION OF BIOACTIVE COMPONENTS FROM TOBACCO INDUSTRY WASTE

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poster presentation

Tobacco industry produce a huge amount of waste, which is categorized as agro-industrial waste. The aim of this work was to investigate the influence of different ultrasound extraction conditions on the content of phenolic components and solanesol in tobacco waste extracts.
Tobacco wastes: fraction 1 (leaf waste and mid-rib) and fraction 2 (dust) were obtained from tobacco factory Hrvatski duhani, Virovitica.
The ultrasound-assisted extraction from tobacco wastes was performed. The influence of extraction temperatures (30, 50, 70 °C), time (15, 30, 45 min), solvent ethanol:water ratio (40%, 60%, 80% v/v) and solvent-solid ratio (10, 30 and 50 mL/g) on the phenolic content of the obtained extracts was investigated. Extraction of solanesol was improved by the addtion of NaOH into the extraction solvent in concentration of 0.05 M, under conditions of temperatures (33.78, 40, 55, 70, 76.2 °C) and time (8.78, 15, 30, 45, 51.21 min). The content of bioactive components was detectey using High Performance Liquid Chromatography (HPLC). The applied ultrasound extraction conditions had statistically significant influence on the content of bioactive components. The extracts of tobacco waste obtained from fraction 1 were characterized by the presence of high levels of chlorogenic acid and rutin with low levels of caffeic acid and solanesol, while in extracts obtained from fraction 2 low levels of chlorogenic acid, rutin and solanesol were determined.

Keywords: tobacco waste, by-product, ultrasound extraction, phenolic components, solanesol

Acknowledgment
This work has been supported in part by Croatian Science Foundation under the project "Application of innovative techniques of the extraction of bioactive components from by products of plant origin" (UIP-2017-05-9909).

SASTAV MASNIH KISELINA U MONOSORTNIM MASLINOVIM ULJIMA DUBROVAČKOG PODRUČJA

CONTENT OF FATTY ACIDS IN MONOVARIETAL OLIVE OILS OF DUBROVNIK AREA

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poster presentation / postersko priopćenje

Maslina je biljka koja može uspijevati na oskudnim i sušnim tlima, a proizvodi koji se temelje na maslini, zahvaljujući popularnosti mediteranske prehrane sve više se koriste u prehrani van mediteranskog područja. Uzgoj masline je i ekonomski važan za mediteransko područje Hrvatske pa se u svrhu dobivanja većih prinosa i što kvalitetnijih maslinovih ulja provode brojna istraživanja.
Sastav masnih kiselina u maslinovom ulju varira u širokim granicama ovisno o sorti, stupnju zrelosti ploda, nadmorskoj visini, klimi i mnogim drugim čimbenicima i koristi se kao parametar kvalitete (pokazuje eventualno patvorenje maslinovih ulja) te u cilju dokazivanja sortnosti i zemljopisnog podrijetla.
U ovom radu prikazani su rezultati ispitivanja sadržaja masnih kiselina u monosortnim maslinovim uljima, najvažnijih i najzastupljenijih sorti dubrovačkog područja (*Bjelica, Crnica, Uljarica, Mezanica, Paštrica i Piculja*) s nekoliko uzgojnih lokacija kroz tri roka berbe u 2017. godini.
Sastav masnih kiselina se odredio plinskom kromtografijom s plameno ionizacijskim detektorom, nakon hidrolize maslinova ulja i metiliranja masnih kiselina s otopinom kalijeva hidroksida u metanolu.

Ključne riječi: maslinovo ulje, masne kiseline, plinska kromatografija

Keywords: olive oil, fatty acids, gas chromatography

BOTANICAL ORIGIN AND ANTIOXIDANT CAPACITY OF BEE POLLEN FROM EASTERN CROATIA

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poster presentation

Bee products are considered to be a good resource of bioactive substances such as flavonoids, phenolic acids or terpenoids. Bee pollen is collected and transported by the bees as granules or pollen-loads and reserved as nutrient resource for honeycomb. Because of its nutritional value and healthful properties, bee pollen is valuable product that can increase the beekeepers' income.
In this work botanical origin and antioxidant capacity of bee pollen collected in eastern Croatia in April and May 2018 were examined. The botanical origin determined by palynological analysis showed that eight out of twelve analysed samples had >45% of the pollen grains coming from one family, while in one sample pollen grains of *Amorpha fruticosa* dominated with 99%.
Total phenolic content, total flavonoids and antioxidant capacity determined by the ferric reducing antioxidant power (FRAP) method were determined by spectrophotometric methods. Total phenolic content ranged from 7.08 to 15.27 mg GAE/g, total flavonoids from 1.34 to 4.25 mg QE/g while FRAP values were from 51.97 to 83.56 μmol Fe^{2+}/g. The highest antioxidant capacity was detected for *Amorpha fructicosa* and *Salix* sp. unifloral bee pollen samples.

Keywords: botanical origin, bee pollen, antioxidant capacity, total flavonoids, total phenolic content

MODERN APPROACHES TO DETERMINING FOOD CONTAMINANTS

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sponsor presentation

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Keywords: LC/TQ, mycotoxin, pesticide, Ultivo, Agilent

KARAKTERIZACIJA NUTRITIVNE KVALITETE HLADNO PREŠANIH ULJA SJEMENKI GROŽĐA

CHARACTERIZATION OF NUTRITIVE QUALITY OF COLD-PRESSED GRAPESEED OILS

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Ulje sjemenki grožđa je u novije vrijeme u fokusu velikog interesa iz dva razloga. Naime, iskorištenjem sjemenki, tj. izdvajanjem ulja iz njih se djelomično rješava problem otpada koji nastaje pri preradi grožđa, a s druge strane, nutricionisti sve više preporučuju upotrebu ovog ulja zbog nezasićenih masnih kiselina, fenolnih spojeva, tokoferola i niskog sadržaja kolesterola. Primjena tehnološkog procesa prešanja sjemenki grožđa na pužnim ili hidrauličnim prešama u posljednje vrijeme je sve zastupljenija u cilju dobivanja potpuno prirodnog, tzv. hladno prešanog ulja. U ovom radu je izvršena karakterizacija nutritivne kvalitete hladno prešanih ulja sjemenki grožđa na bazi sadržaja određenih biomolekula. Ispitani su uzorci ulja dobiveni od sjemenki crnog grožđa sorte *Merlot*, bijelog grožđa sorte *Talijanski Rizling* i *Sila*, u usporedbi s uzorkom rafiniranog ulja. Najveći sadržaj ukupnih tokoferola i tokotrienola (575,23 ± 4,46 mg/kg) nađen je u ulju koštice grožđa sorte *Merlot*, a najmanji u rafiniranom ulju (391,06 ± 7,64 mg/kg). Od fenolnih komponenti najzastupljenija frakcija bila je ursolna kiselina, od 34,1 ± 5,3 μg/g u rafiniranom ulju, do 212 ± 17 μg/g u ulju koštice grožđa sorte *Sila*. Najveći sadržaj ukupnih fenolnih spojeva, 12,66 ± 1,07 mg/kg, utvrđen je u ulju sjemenki crnog grožđa sorte *Merlot*. Razmjerno sadržaju tih komponenti sa antioksidativnim potencijalom vrijednost EC_{50} se kretala u rasponu od 65,34 ± 0,32 do 127,17 ± 1,23 mg ulja/mg DPPH.

Ključne riječi: ulje sjemenki grožđa, tokoferoli, fenolni spojevi, antiradikalni potencijal

Keywords: grapeseed oil, tocopherols, phenolic compounds, antiradical potential

ANTIOKSIDATIVNA AKTIVNOST PRIRODNOG I TERMIČKI OBRAĐENOG SOKA OD VIŠNJE

ANTIOXIDATIVE ACTIVITY OF NATURAL AND THERMALLY PROCESSED CHERRY JUICE

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poster presentation / postersko priopćenje

Mnoga znanstvena istraživanja ukazuju na pozitivnu korelaciju između konzumiranja voća i prevencije razvoja raznih bolesti. Poznato je da voće sadrži pored nutrijenata i značajnu količinu polifenolnih spojeva, koji se posebno ističu kod tamno obojenog bobičastog i jagodastog voća. Biološka aktivnost polifenola prvenstveno je izražena njihovim antioksidativnim kapacitetom, a od velikog su interesa i za nutricioniste i prehrambene tehnologe zbog mogućnosti korištenja kao sastojaka za proizvodnju funkcionalne hrane.
Cilj ovog rada bio je ispitati kvalitetu svježe ocijeđenog soka od višnje, kojem je dodan konzumni šećer, te utjecaj pasterizacije na antioksidativnu aktivnost soka. Sok je pasteriziran pri temperaturi od 80 °C. Pasterizacija je utjecala na smanjenja sadržaja vitamina C, antocijana, ukupnih fenola i antioksidativne aktivnosti soka od višnje.

Ključne riječi: sok od višnje, antioksidativna aktivnost, fenoli

Keywords: cherry juice, antioxidative activity, phenols

MIKROBIOLOŠKA I KEMIJSKA KVALITETA IZVORSKE NEPROČIŠĆENE I KLORIRANE VODE ZA PIĆE SA IZVORA KLOKOT

MICROBIOLOGICAL AND CHEMICAL QUALITIES OF POLLUTED SPRING WATER AND CHLORINATED DRINKING WATER FROM THE SPRING OF KLOKOT

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poster presentation / postersko priopćenje

Glavni cilj u proizvodnji i distribuciji vode za piće je osigurati mikrobiološku i kemijsku ispravnost vode za piće, jer prisutnost patogenih bakterija i toksičnih kemijskih spojeva u vodi za piće predstavlja značajan rizik za zdravlje ljudi.
Ispitivanje vode je napravljeno na uzorcima izvorske nepročišćene vode i klorirane vode iz postrojenja J.P. "Vodovod" Bihać. U razdoblju od srpnja 2017. godine do srpnja 2018. godine ispitano je 80 uzoraka vode, od toga je bilo 20 uzoraka izvorske nepročišćene vode i 60 uzoraka klorirane vode iz javnih vodoopskrbnih sustava (nakon dezinfekcije).
Utvrđeno je da je voda sa izvora Klokot nakon kišnih razdoblja pokazala prisutnost *entero* i *coli* mikroorganizama, te povećan broj mikroorganizama, koji kod korisnika mogu izazvati stomačne i crijevne promjene, visoku temperaturu, dijareju i povraćanje. U vodi koja je u postrojenjima prošla obradu, i kasnije izvođenjem metode membranske filtracije nisu utvrđeni koliformi i drugi kontaminanti.
Od fizičko-kemijskih analiza određeni su slijedeći parametri: pH, električna vodljivost, miris, okus, mutnoća, utrošak $KMnO_4$, amonijak, nitriti, nitrati, rezidualni klor i željezo. Određeni analizirani parametri odstupaju od MDK vrijednosti koje su propisane Pravilnikom o zdravstvenoj ispravnosti vode za piće (objavljeno u "Sl. glasnik BiH", br. 40 43/10, 30/12), 3 uzoraka klorirane vode nisu dala odgovarajuće rezultate i to za pokazatelje mutnoće, dok su 2 uzorka imala povišenu koncentraciju amonijaka.

Ključne riječi: mikrobiološko ispitivanje, izvorska voda, klorirana voda, mutnoća

Keywords: microbiological testing, spring water, chlorinated water, fuzinnes

PHENOLICS AND METHYLXANTHINES PROFILE OF COCOA SHELL AND THE EFFECT OF COLD PLASMA TREATMENT ON THEIR CONTENT

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poster presentation

Cocoa shell, a by-product of cocoa industry, is valuable source of dietary fibers, phenolics, methylxantines and vitamins. Recently, the presence of high-valuable bioactive components in cocoa shell was recognised and the pallet of food products enriched with cocoa shell is increasing. The most abundand bioactive components of cocoa shell are methylxanthines (theobromine and caffeine) and flavanols (catechins, epicatechins and procyanidins). Cold plasma treatment is often used for decontamination of products but also effects food constituents. The aim of this study was to determine bioactive component profiles of cocoa shell and evaluate the effect of cold plasma treatment of their composition and content. Qualitative and quantitative determination of 6 phenolic components (gallic acid, caffeic acid, *p*-coumaric acid, (+)-catechin, (-)-epicatechin and (-)-epicatechin gallate) and 2 methylxanthines (theobromine and caffeine) was performed by chromatographic method with absorbance detection, while total phenolic content was determined by Folin-Ciocalteu method. The results showed that theobromine, caffeine and (+)-catechin are major bioactive components of cocoa shell followed by gallic acid and (-)-epicatechin. Although water extraction decreased the content of bioactive components compared to untreated cocoa shell, the decrease was lower when cold plasma treatment was applied.

Keywords: cocoa shell, phenolic components, methylxanthines, cold plasma treatment

Acknowledgment
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VOLATILE COMPOUNDS OF PHACELIA (*Phacelia tanacetifolia* Benth.) HONEY BEFORE AND AFTER HEATING

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poster presentation

Many compounds of biological and botanical origin such as volatile substances are unstable. In honey the structures of volatile substances can be transformered during maturation, storage and heating. In this paper the influence of phacelia honey heating on the composition and content of volatile compounds is investigated. The honey sample were heated at 150 °C (5 min.) without addition of water, to notice thermal artifacts. Volatile compounds were extracted with dichloromethane using ultrasound assisted solvent extraction (USE) at room temperature. The extracts were analyzed by gas chromatography-mass spectrometry (GC-MS). *Phacelia tanacetifolia* Benth. honey biomarker syringaldehyde proved to be stable throughout heating procedure up to 150 °C. The dominant compounds identified in dichloromethane extract obtained after heating of honey at 150 °C were thermal artefacts 5-hydroxymethylfurfural and pyran derivative 2,3-dihydro-3,5-dihydroxy-6-methyl-4*H*-pyran-4-one.

Keywords: phacelia honey heating, USE, GC-MS analysis, volatile compounds, thermal artefacts

THE INFLUENCE OF NITROGEN FERTILIZATION ON PROTEIN AND TOTAL PHENOLIC CONTENT OF WHEAT

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poster presentation

Whole grains are rich sources of fiber, proteins, vitamins, minerals and phytochemicals (carotenoids, tocopherols, tocotrienols, phenolic acid, phytic acid, phytosterols and flavonoids) that may contribute to its antioxidant capacity. Twelve wheat cultivars (*Triticum aestivum* L.) of the Agricultural Institute Osijek were grown during the season 2016/2017 at standard N fertilization (115 kg N/ha) and additional foliar fertilization with 15% urea. In whole grain protein content (P) was measured by NIT analyzer Infratec 1241, while total phenolic content (TPC) was determined with the Folin-Ciocalteu Reagent that in the reaction with phenols reduces to a blue coloured oxide. The intensity of the resulting colour was measured in a spectrophotometer at 765 nm. Protein content under additional N supply was increased on average by 25.28%, while TPC was decreased by 7.23%. The response of cultivars to additional N fertilization is specific, so the largest increase in P had cultivars Katarina, Renata and Galloper, while the largest decrease in TPC had cultivars El Nino, Silvija and Kraljica.

Keywords: wheat, N fertilization, protein, total phenolic content

THE INFLUENCE OF PITS PRESENCE DURING FERMENTATION ON COLOUR AND AROMA COMPOUNDS OF CHERRY WINE

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poster presentation

Colour and aroma compounds are important constituents of cherry wines as they contribute to their quality. Studies have shown that cherry wine is a rich source of polyphenols, anthocyanins and antioxidants. Aroma profile of cherry wine is a result of different metabolic pathways that occurs during fruit ripening, fermentation of the juice and wine storage. The fermentation of cherry juice can be conducted with or without cherry pit removal. The aim of this study was to determine the influence of pits presence during fermentation on final product. The results have shown that the wine produced without pit removal had lower concentration of polyphenols, anthocyanins, polymeric colour and lower antioxidant activity, compared with the wine produced from cherries without pits. On the other hand, the wine fermented with pits had a more complex aroma and higher number of aroma compounds was identified in it in comparison to the other sample. All aroma compounds that were identified in samples, were classified in five groups (alcohols, acids, terpenes, carbonyl compounds and esters), with esters and terpenes being the largest group. Among terpenes, thymol and carvacrol were identified, that are considered to have antimicrobial properties.

Keywords: cherry wine, pits, colour compounds, aroma profile

SUPERCRITICAL CO_2 EXTRACTION OF VOLATILE COMPOUNDS FROM MANDARIN PEELS

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poster presentation

During the industrial processing of mandarin, large amounts of wastes, including peels, are produced. Since it was shown that the peels contain higher concentration of bioactive compounds compared to pulps and thus have more potential for being used as source of bioactive compounds. Mandarin peels, due to its compounds, have been found to have health-related properties including antioxidant, anticancer and anti-inflammatory.

The peels of *Citrus reticulata* Blanco cultivars of different varieties (*Zorica rana, Chahara, Okitsu, Kuno*) from the Opuzen were extracted by supercritical CO_2 (SC-CO_2) at extraction temperature of 40°C and at two different pressures (100 and 300 bars). The extracts were analysed in detail by gas chromatography/mass spectrometry (GC/MS). The limonene predominance was found in samples from varieties *Zorica rana, Okitsu* and *Kuno*, followed by eremophylene in varieties *Zorica rana*, *Chahara* and *Okitsu*, and γ-terpinene in variety *Kuno.*

The results showed that volatile compositions were completely different among investigated mandarin varieties. Furthermore, SC-CO_2 extraction applied to food by-products such as mandarin peel exhibited a strong potential for the industrial development in the production of the extracts rich in bioactive compounds.

Keywords: mandarin peel, by-product, supercritical CO_2 extraction, GC-MS

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PROCJENA KVALITETE MEDA U UGOSTITELJSKIM OBJEKTIMA PRIMORSKO-GORANSKE I ISTARSKE ŽUPANIJE ISPITIVANJEM UDJELA HIDROKSIMETILFURFURALA

QUALITY ASSESSMENT OF HONEY IN COFFE BARS LOCATED IN PRIMORSKO-GORANSKA AND ISTRA COUNTY BY DETERMINING HYDROXYMETHYLFURFURAL CONCENTRATION

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poster presentation / postersko priopćenje

Med je prirodni proizvod koji se koristi u prehrani od pamtivijeka. Medonosne pčele (*Apis mellifera*) prikupljaju nektar medonosnih biljaka, sekreta živih dijelova biljaka ili izlučevina kukaca koji sišu na živim dijelovima biljaka, mijenjaju ga, dehidriraju i pohranjuju u saće. Zbog porasta svijesti o važnosti pravilne prehrane u očuvanju zdravlja, sve više potrošača koristi med za zaslađivanje umjesto konzumnog šećera, budući med osim velikog udjela šećera (uglavnom fruktoze i glukoze) sadrži i mnoge biološki vrijedne sastojke poput fenolnih komponenti, flavonoida, enzima, organskih kiselina, minerala i vitamina. Svrha ovog istraživanja bila je ispitati kvalitetu meda dostupnog potrošačima u ugostiteljskim objektima u Primorsko-goranskoj i Istarskoj županiji, u pogledu sadržaja hidroksimetilfurfurala (HMF) kao pokazatelja svježine i termičke obrade meda. Prisustvo HMF-a ispitano je u 30 uzoraka cvjetnog meda metodom tekućinske kromatografije visokog učinka sa *diode array* (DA) detekcijom. U 17% uzoraka određeni maseni udio HMF bio je veći od najveće dopuštene količine definirane Pravilnikom o medu (MP RH, NN 53/2015, 47/2017), što upućuje na potrebu razvoja sustava praćenja kvalitete meda na tržištu Republike Hrvatske.

Ključne riječi: med, hidroksimetilfurfural, kvaliteta

Keywords: honey, hydroxymethylfurfural, quality

THE IMPACT OF NOVEL EXTRACTION TECHNIQUES ON THE POLYPHENOL PROFILE OF GRAPE POMACE

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The impact of cold atmospheric plasma (CAP) and ultrasound (US) assisted extraction on gallic acid, *p*-coumaric acid, caffeic acid, catechin, epicatechin and quercetin from dried grape pomace was investigated. The solvents used for the extraction were aqueous solution of ethanol or methanol, acidified with hydrochloric acid (49.5:49.5:1). The investigated parameters in case of CAP were treatment time (5, 10, 15 min) and frequency (20, 50, 100 Hz), and in the case of US, treatment time (5, 10, 15 min) and temperature (20, 40, 80 °C). The results showed that in both cases the better extraction solvent was ethanol acidified with hydrochloric acid. The highest yields in extracts obtained by CAP assisted extraction have been achieved by extracting polyphenols at 100 Hz for 15 min. The contents of gallic acid, *p*-coumaric acid, caffeic acid, catechin, epicatechin and quercetin were 4.21; 6.80; 54.09; 53.68; 53.19; 45.31 mg/100 g DW, respectively. In extracts obtained by US assisted extraction, the highest content of investigated polyphenols have been achieved by extracting polyphenols at 80 °C for 15 min. The contents of gallic acid, *p*-coumaric acid, caffeic acid, catechin, epicatechin and quercetin were 2.32; 5.87; 36.19; 40.25; 23.02; 24.97 mg/100g DW, respectively. Contents of all investigated polyphenols were higher in extracts obtained by CAP assisted extraction.

Keywords: cold plasma, ultrasound, grape pomace, polyphenol profile

MIKOTOKSINI: UTJECAJ NA ZDRAVLJE I ANALITIKA

MYCOTOXINS: THE IMPACT ON HEALTH AND ANALYTICS

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sponsor presentation / sponzorsko predavanje

Odličan primjer za isticanje problematike mikotoksina je pomor velikog broja purana 60tih godina prošlog stoljeća za što je bio kriv aflatoksin. Ovaj događaj je potaknuo istraživače da podrobnije prouče mikotoksine i procjene njihov utjecaj na ljudsko zdravlje. Od tada su identificirani brojni mikotoksini. Konzumiranje namirnica sa velikim udjelom mikotoksina može prouzročiti smanjen apetit, mučninu, povraćanje i proljev. Kronična izloženost nižim koncentracijama mikotoksina može negativno utjecati na aktivnost imunološkog sustava, uzrokovati pojavu raka, negativno utjecati na fetus, a neki mikotoksini djeluju kao hormonski regulatori.

Prisutnost i količinu mikotoksina u uzorcima može se odrediti pomoću ovlaštenih analitičkih metoda (različite vrste kromatografije, kao što su TLC, GLC, HPLC, MS), u proizvodnim pogonima ili otkupnim mjestima mogu se koristiti brze rutinske metode poput imuno-enzimskih (ELISA) i imunokromatografskih (Lateral Flow Tehcnology). Prednost odgovarajućih rutinskih metoda nad standardnim analitičkim metodama su brzina, jednostavnost i niski troškovi, uz visoki stupanj pouzdanosti.

Charm Sciences Inc. je vodeći proizvođač imunokromatografskih testova i opreme za analitiku tvari u tragovima. Prvenstveno prednjači u tehnologiji ekstrakcije mikotoksina s vodom, a pouzdanost tih testova potvrđuju mnoge akreditacijske organizacije poput USDA GIPSA*.

Prilikom komparativnog istraživanja belgijskog nacionalnog referentnog laboratorija CODA-CERVA**, Charm testovi za utvrđivanje DON mikotoksina su postigli najbolje ocjene u kategorijama točnosti, ponovljivosti i limita detekcije, a bili su jedini testovi odobreni kao dovoljno pouzdani za upotrebu na terenu. Iskustvo sa uzorcima iz Hrvatske i Slovenije potvrđuju međunarodne rezultate.

Ključne riječi: mikotoksini, zdravlje, analitika

Keywords: mycotoxins, health, analytics

**Unated States Department of Agriculture; Grain Inspection, Packers & Stockyards Administration, Laws & Regulations;*
***CODA-CERVA as National Reference Laboratory (NRL) for mycotoxins; Veterinary and Agrochemical Research Centre, Operational Directorate of Chemical safety of food chain, Unit of Toxins and Natural Components, Belgium*

EVALUATION OF PHENOLIC CONTENT AND ANTIOXIDANT CAPACITY OF MASTIC TREE FRUITS (*Pistacia lentiscus* L.) GROWN IN DIFFERENT LOCATIONS IN CROATIA

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Mastic tree (*Pistacia lentiscus* L.) is a Mediterranean evergreen shrub of the family Anarcadiaceae. Different tree parts (leaves, stems, fruits, roots) are widely used in traditional medicine to treat diseases such as throat infections and diarrhea due to the presence of phenolic compounds, vitamins and minerals. The aim of this study was to evaluate total phenolics (TP), flavonoids (TF), hydroxycinnamic acids (THCA) and flavonols (TFlav) of mastic tree fruits as well as its antioxidant activity (AA) grown in different location in Croatia (Barbariga/Lun/Hvar/Korčula). Fruits were harvested in October 2017. The mean TP content ranged from 10.81 to 3.02 mg/g, TF from 1.28 to 2.71 mg/g, THCA from 1.33 to 3.98 mg/g and TFlav from 2.23 to 4.64 mg/g. Almost all phenolics (TP, TF, TFlav) were the highest in fruits harvested in Hvar except THCA which were the highest in fruits from Barbariga. Generally, fruits from Korčula had the lowest content of phenolics (TP, THCA, TFlav) except TF content which was the lowest in Barbariga. The highest (78.71 mg/g) and the lowest (30.44 mg/g) AA was determined in fruits from Hvar and Korčula, respectively. Growing location considerably affected phenolic content and AA of mastic tree fruits.

Keywords: antioxidant activity, growing location, mastic tree fruits, phenolics

SHIMADZU RJEŠENJA ZA ANALIZE HRANE

SHIMADZU SOLUTIONS FOR FOOD ANALYSIS

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sponsor presentation / sponzorsko predavanje

Kvantitativna analiza specija arsena pomoću sustava LC-ICPMS

Obzirom da toksičnost „toksičnih elemenata u tragovima“ ne ovisi samo o koncentraciji, nego također i o vrstama specija koje su prisutne u određenom uzorku, postoji potreba za kontrolom specija i u uzorcima hrane.
Shimadzu korporacija nudi gotovo rješenje za analizu specija arsena u riži vezanim sustavom HPLC-ICPMS s parametrima metode, pripremom uzoraka i obradom podataka. Ovakvom analizom se mogu dobiti dodatni odgovori o toksičnosti i mobilnosti elemenata koji su prisutni u uzorcima hrane.

Visoko osjetljiva analiza akrilamida u čipsu pomoću sustava LC-MSMS

Organizacija „Europian Food Safety Authority“ je potvrdila prethodne procjene da akrilamid u hrani potencijalno povećava rizik od razvoja raka kod potrošača u svim dobnim skupinama, te je time potvrđena potreba za kontrolom akrilamida u hrani.
Shimadzu korporacija nudi gotovo rješenje za analizu akrilamida u čipsu pomoću sustava LC/MS/MS, s uključenom pripremom uzorka čipsa metodom modificiranih „Quechersa“. „Quechers“ metoda je brza i učikovita u ekstrakciji akrilamida iz čipsa. Izvrsna osjetljivost, linearnost i ponovljivost metode je omogućena zahvaljujući izvanrednoj učikovitosti LC/MS/MS sustava koji koristi ultra-brzu tehnologiju masene spektrometrije. Visoka osjetljivost metode omogućuje analize s malim volumenima injektiranja, što je velika prednost za analize kompleksnih uzoraka poput uzoraka hrane s velikim utjecajem matriksa.

Ključne riječi: analiza specija, LC-ICPMS, akrilamid, LC/MS/MS

Keywords: species analysis, LC-ICPMS, acryamide, LC/MS/MS

PHYSICOCHEMICAL AND SENSORY CHARACTERISTICS OF GREEN OLIVE PASTES

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The main ingredients of olive pastes are table olives and virgin olive oil. It is well known that olives and olive oil have beneficial effects on human health hence these effects are attributed to olive pastes. The aim of this study was to investigate the physicochemical and sensory characteristics of five commercial green olive pastes purchased in retail and one green olive paste with marinated shallots. This last sample was used as a test sample in order to evaluate the overall acceptability of green olive paste with marinated shallots by the consumers. Physicochemical analyses showed the different results in pH, titratable acidity, salt content, dry matter content and water activity. According to the results of the analyses, among the samples were established the differences by individual tested properties at the level of statistical significance which indicates the differences in the products recipes and production processes. All green olive pastes were recognized as generally acceptable by the panelists, while sample which presented green olive paste with marinated shallots was the most preferred regarding the overall sensory attributes, therefore indicating the possibility of producing and developing a wide range of olive products with different ingredients.

Keywords: green olives, shallots, paste, physicochemical, sensory characteristics

BIOLOGICAL TREATMENT OF GRAPE POMACE WITH *Ganoderma lucidum*

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poster presentation

Ganoderma lucidum is a well-known mushroom used in traditional Chinese medicine for promoting health. It has ability to grow on a variety of different substrates under solid-state conditions. It produces a coctail of extracellular enzymes which are able to degrade lignin and cellulose leading to formation/release of valuable compounds.
The aim of this work was to investigate the biological treatment of grape pomace from *Cabernet Sauvignon* (GP) with *G. lucidum* during fifteen days on the enhancement of phenolic acids content in GP extracts. The biological treatment of GP proved to be a positive technique for the recovery of phenolic acids such as gallic acid (GA), protocatechuic acid (PA), syringic acid (SA), vanillic acid (VA), *p*-hydroxybenzoic acid (*p*-HBA), *p*-coumaric acid (*p*-CuA) and ferulic acid (FA).
The initial concentrations of phenolic acids in GP extracts were 199.88 $\mu g/g_{db}$, 133.46 $\mu g/g_{db}$, 79.01 $\mu g/g_{db}$, 34.35 $\mu g/g_{db}$, 5.18 $\mu g/g_{db}$, 5.11 $\mu g/g_{db}$ and 4.5 $\mu g/g_{db}$ for GA, PA, SA, VA, *p*-HBA, FA and *p*-CuA, respectively. Enhancement of phenolic content in GP extracts were observed during the first three days of the treatment, and were in range from 2.6-fold (GA) to 1.2-fold (SA, VA, FA).

Keywords: grape pomace, *Ganoderma lucidum*, solid-state fermentation, phenolic compounds

CHEMICAL COMPOSITION OF CEREAL WHOLEGRAIN MEALS AND FLOURS

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The large portion of everyday consuming foods has in its base products made from different cereals. Cereal grains can be processed into various baked products, pasta, noodles, pies, biscuits, cookies and breakfast cereals. For well-balanced diet cereals and pseudo-cereals offer many desirable nutritive ingredients like proteins, dietary fibres and oligosaccharides, vitamins and minerals. Other phytochemical components include phenolic acids, flavonoids, phytic acid, tocopherols and tocotrienols, which provide health benefits due to its antioxidant activity. In this study we evaluated milling products of different cereals for their chemical composition, β-glucans, total phenolic content and antioxidant activity, as determined by the DPPH radical scavenging method. The results showed considerable differences in chemical composition between analyzed grain meals. Pseudo-cereal buckwheat and hull-less barley accumulated the highest amounts of protein (17.55% and 14.29%, respectively), and lowest protein content was measured in rye flour (6.16%). In addition, the wholegrain flour of buckwheat contained the highest total phenolic content (2.45 mgGAE/g d.w.) and DPPH radical scavenging activity (89.07% inhibition) when compared to other cereal grains. Among analyzed wholegrain and flour samples the highest content of β-glucans was found in hull-less barley (5.54%) and lowest in buckwheat and corn flour (0.12% and 0.15%, respectively).

Keywords: cereal, pseudo-cereal, grains, protein, total phenolic content

ANTIOXIDANT ACTIVITY OF THE PHENOLIC EXTRACTS FROM OLIVE OILS FROM THE ISLAND OF HVAR

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poster presentation

Mediterranean diet and the significant consumption of olive oil have been associated with a lower risk of cardiovascular diseases, health improvement in the obese patients, reduction of diabetic occurance, prevention of the cognitive decline due to aging, prolongation of a life span and life quality in eldery population. Relationship between total polyphenolic content and antioxidant activity is very well established. Furthermore strong antioxidant and anti-inflammatory properties of polyphenolic compounds in olive oils have been reported. In this study 11 diferent samples of olive oil from the Hvar Island, Croatia, have been investigated. Polyphenolic compounds have been extracted and total polyphenolic content was determined. Results have been shown as mg equivalent of caffeic accid in kg of olive oil. In addition the samples have been analysed for antioxidant activity by ORAC and DPPH method. The results are presentend as μmol equvalent of Trolox per mL and statistically interpreted using ANOVA. Significant correlation between total amount of polyphenolic compound and antioxidant activity has been shown.

Keywords: Mediterranean diet, polyphenolic compounds, antioxidant activity, ORAC, DPPH

VOLATILE COMPOUNDS OF MACEDONIAN DRY FERMENTED SAUSAGE (*SUDZUK*) DURING RIPENING

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oral presentation

The profiles of volatile compounds of Macedonian dry fermented sausages (*Sudzuk*) were analyzed by gas chromatography-mass spectrometry (GC–MS) using a solid phase microextraction (SPME). A total of 129 volatile compounds were identified and were consisted of 31 terpenes, 16 esters, 20 ketones, 9 acids, 26 alcohols and 27 miscellaneous. The analysis of the main volatile aromatic components proved that 67% of the compounds that were detected on the first days are terpenes and their content increase until the last day to 84%. The 80% of total concentration of volatile components is formed at the last day (15) of ripening. The ketones (89%) and terpenes (82%) are the most common groups of detected volatile compounds.
Sudzuk contain high levels of spicy terpens, which showed strong aroma and could play an important role in the general sensory notes of this meat product. Other important compounds were acids (especially acetic acid), sulfur compounds (diallyl disulfide, 1-propene 3-thiobis, methyl-2-phenyl disulfide) and aldehydes (*p*-cumic aldehyde). There were significant differences between the various groups of the investigated samples. These differences in the volatile profiles of sausage specimens can be explained by the differences in raw materials, used spices and other ingredients as well as by the production conditions.

Keywords: volatile compounds, *Sudzuk*, SPME, GC-MS

ODREĐIVANJE SADRŽAJA UKUPNIH FENOLA I ANTIOKSIDATIVNOG KAPACITETA KOMERCIJALNIH ZELENIH ČAJEVA IZ TUZLANSKIH MARKETA

DETERMINATION OF TOTAL FENOLS AND ANTIOXIDATIVE CAPACITY OF COMMERCIAL GREEN TEA FROM TUZLA SUPERMARKETS

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Zeleni čaj, koji se proizvodi od lišća biljke *Camellia sinensis*, jedno je od najpopularnijih pića na svijetu. Proteklih desetljeća znanstvenici su proučavali ovu biljku u pogledu potencijalnih zdravstvenih prednosti. Istraživanja su pokazala da zeleni čaj pomaže u prevenciji moždanog udara, razvoja malignih bolesti i infekcija. U ovom radu ispitana je antioksidativna aktivnost i sadržaj ukupnih fenola 4 uzorka zelenog čaja iz lokalnih tuzlanskih marketa, od kojih su dva inozemnog porijekla. Antioksidativna aktivnost uzoraka analizirana je primjenom FRAP i DPPH metode. Dobiveni rezultati pokazuju da najveći sadržaj ukupnih fenola i najveći antioksidativni kapacitet ima uzorak inozemnog porijekla. Sadržaj ukupnih fenola u uzorcima kreće se u rasponu od 3394,84 do 4474,85 mg GAE/L ekstrakta. Najveća FRAP vrijednost iznosi 9241 mg/mL Fe^{2+}. Antioksidacijski kapacitet potvrđen je i DPPH metodom. U tu svrhu određena je IC50 vrijednost koja se kreće u rasponu od 30,19 do 75,72 μg/mL. Analizom je utvrđeno da antioksidacijska aktivnost čajeva nije usko vezana s cijenom čajeva.

Ključne riječi: ukupni fenoli, FRAP, DPPH, zeleni čaj

Keywords: total phenol, FRAP, DPPH, green tea

OPTIMIZATION OF PEACH (*P. persica*) VACUUM DRYING PROCESS BY RESPONSE SURFACE METHODOLOGY (RSM)

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poster presentation

The objective of this work was to optimize the vacuum drying of peach (*P. persica*) in order to find the best vacuum drying conditions for preserving physical, chemical and biological properties of fresh peach. Fresh peach was dried by vacuum drying process under different drying conditions. The drying process is optimized by using the Response Surface Methodology (RSM). Moisture content, water activity, total color change, shear force, total phenolic compounds and antioxidant activity were used as quality indicators of dried peach. Temperature (50 – 70 °C), pressure (20 – 120 mbar) and drying time (6 – 10 h) were investigated as independent variables. The optimal conditions for vacuum drying of peach were obtained in this research. Fresh peach was also dried by lyophilization and conventional drying in order to compare quality of samples dried by different drying techniques.

Keywords: peach (*P. persica*), vacuum drying, physical, chemical and biological properties, optimization

UTJECAJ LOKACIJE I MODELA GNOJIDBE NA MINERALNI SASTAV LISTA I PLODA BARANJSKE ZAČINSKE PAPRIKE

INFLUENCE OF LOCATION AND FERTILIZATION MODEL ON LEAF AND FRUIT MINERAL NUTRIENT COMPOSITION OF BARANYAN SPICE PEPPER

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oral presentation / usmeno priopćenje

Nedavno opisana autohtona baranjska začinska paprika nema definiranu proizvodnu tehnologiju te nije poznato kako agroekološki uvjeti i gnojidba utječu na rast i razvoj te usvajanje makro- i mikroelemenata biljke. Cilj ovog istraživanja je bio utvrditi utjecaj modela gnojidbe i lokacije na mineralni sastav lista i ploda autohtone baranjske začinske paprike. Istraživanje je provedeno tijekom 2017. godine na tri različite lokacije u Baranji i to u Karancu, Lugu i Branjin Vrhu te su primjenjena četiri različita modela gnojidbe. Tijekom istraživanja su uzorkovani listovi iznad prvog grananja i plodovi po dozrijevanju koji su podvrgnuti analizi mineralnog sastava. Statističkom analizom je utvrđeno da je lokacija značajno utjecala na koncentraciju N, K, Mg, Ca, Cu, Fe i Mn te nije utjecala na koncentraciju Zn u listu i plodu paprike. Model gnojidbe je značajno utjecao na koncentraciju Mg, Cu i Mn u listu te Mg, Ca i Cu u plodu paprike. Iz navedenog se može zaključiti da mineralni sastav lista i ploda autohtone začinske paprike ovisi o modelu gnojidbe te lokaciji tj. opskrbljenosti tla s organskom tvari i hranivima budući da je tlo na lokaciji Karanac analizom okarakterizirano kao najbogatije tlo zalihama hraniva i organske tvari.

Ključne riječi: začinska paprika, model gnojidbe, lokacija, mineralni sastav

Keywords: spice pepper, fertilization model, location, mineral composition

THE CONTENT OF BIOGENIC AMINES IN CROATIAN WINES OF DIFFERENT GEOGRAPHICAL ORIGINS

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poster presentation

Samples of white and red wines produced in two different wine-growing regions, coastal (Dalmatia) and continental (Hrvatsko zagorje) of Croatia, were analysed for biogenic amines content. Biogenic amines content was determined, and its concentration levels were associated to the geographical origin of the wine. Due to its high sensitivity, HPLC method with ultraviolet detector was used, including derivatisation step by dansyl chloride. The method was applied to detect and quantify 11 biogenic amines in 48 red and white wines. It was found that both Dalmatian red and white wines are characterized by tryptamine (0.23-1.22 mg L^{-1}), putrescine (0.41-7.5 mg L^{-1}) and ethanolamine (2.87-24.32 mg L^{-1}). White wines from Hrvatsko zagorje region are characterized by content of isopentylamine (0.31-1.47 mg L^{-1}), putrescine (0.27-1.49 mg L^{-1}) and ethanolamine (3.80-17.96 mg L^{-1}). In contrast to white wines from Hrvatsko zagorje region, in red wines were found and equally presented all biogenic amines except ethylamine.

Keywords: Croatian wines, biogenic amines, HPLC, geographical origin

THE INFLUENCE OF DIFFERENT STABILIZATION REGIMES ON BEER STABILITY

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poster presentation

Beer stability implies the microbiologically and colloidly stable beer that retains all its characteristics within the prescribed period of use. The stabilization process refers to the protection of the final product from the changes that may occur after filling the product in its packaging. Changes that may occur are flavor changes, blur under the influence of the biological factors and blur caused by the influence of the non-biological factors. Focus of this paper was blur caused by the influence of the non-biological factors – colloidal instability. Colloidal instability is mostly caused by proteins and polyphenols.
The aim of the paper was to achieve various stabilization regimes during stabilization of the bright beer, and to determine which regime is the most effective. Turbidity and polyphenol content measurements were carried out by various methods as Chapon test, test with tannic acid and seven day test. Eighteen samples of the bright beer produced under different stabilization regimes were tested. Stabilization regimes differed based on the combination of filtration materials (Silica gel and Polyvinyl Polypyrrolidone) and its dosing rates.

Keywords: bright beer, stabilization, filtration materials, polyphenols, proteins

PRODUCTION OF SAFE FOOD AND FOOD WITH ADDED NUTRITIONAL VALUE /

PROIZVODNJA ZDRAVSTVENO SIGURNE I NUTRITIVNO VRIJEDNE HRANE

APPLICATION OF ARTIFICAL INTELIGENCE AND MACHINE LEARNING IN FOOD INDUSTRY AND NUTRITION

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poster presentation

In last few decades, rapid development of digital computes and computing power enabled significant progress in research of artificial intelligence (AI) and machine learning and its application in different fields of science, industry and everyday life. AI and machine learning enables analysis of large amount of data of different origin and type and identification of underlying patterns. This paper gives overview and classification of most frequent used algorithms and their applications in food industry (food science and research) and nutrition. The results suggest a great potential in application of AI and machine learning in the food industry (quality and safety control), food research and development and nutrition.

Keywords: food, artificial inteligence, machine learning

ULTRAZVUČNA EKSTRAKCIJA ANTIOKSIDANASA IZ VRŠNIH DIJELOVA INDUSTRIJSKE KONOPLJE I OPTIMIZACIJA PROCESA

ULTRASOUND-ASSISTED EXTRACTION OF ANTIOXIDANTS FROM CANNABIS SATIVA AREAL PARTS AND PROCESS OPTIMIZATION

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poster presentation / postersko priopćenje

Za dobivanje optimalnih uvjeta ultrazvučne ekstrakcije (UAE) bioaktivnih komponenti iz vršnih dijelova industrijske konoplje ispitan je i analiziran pomoću metode odzivne površine utjecaj tri nezavisno promjenjiva UAE parametra (temperatura ekstrakcije (40 – 80 °C), vrijeme ekstrakcije (20 – 60 min) i snaga ultrazvuka (24 – 60 W)). Za promatrane odzive su odabrani ukupni fenoli (TP), ukupni flavonoidi (TF), kao i antioksidativne aktivnosti ekstrakta, izražene preko IC_{50} vrijednosti i redukcijske sposobnosti ekstrakta, izražene preko EC_{50} vrijednosti, Za ekperimentalni dizajn izabran je Box-Behnkenov dizajn. U dobivenim ekstraktima sadržaj ukupnih fenola je bio od 1,0552 do 1,7795 mg EGK/mL ekstrakta, a ukupnih flavonoida je bio od 0,3793 do 0,6749 mg EK/mL ekstrakta. Antioksidativna aktivnost je bila u rasponu od 0,0013 do 0,0021 mL ekstrakta/mL reakcijske smjese, dok je redukcijska sposobnost bila od 0,0036 do 0,0057 mL ekstrakta/mL reakcijske smjese. Eksperimentalni rezultati su opisani modelom polinoma drugog stupnja. Model je provjeren analizom varijance (ANOVA). ANOVA je pokazala da faktor koji ima najveći utjecaj na UAE proces za sve promatrane odzive jest temperatura ekstrakcije čije su *p*-vrijednosti za sve odzivne parametre bile manje od 0,01. Na optimalnim uvjetima ekstrakcije 68,8 °C, 54,8 min i 60 W predviđeno je da će sadržaj ukupnih fenola iznositi 1,5245 mg EGK/mL ekstrakta, sadržaj ukupnih flavonoida 0,6214 mg EK/mL ekstrakta, antioksidativna aktivnost 0,0014 mL ekstrakta/mL reakcijske smjese i redukcijska sposobnost 0,0039 mL ekstrakta/mL reakcijske smjese.

Ključne riječi: industrijska konoplja, ultrazvučna ekstrakcija, fenoli, antioksidansi

Keywords: *Cannabis sativa*, ultrasound-assisted extraction, phenols, antioxidants

THE EFFECT OF PLANT EXTRACT ADDITION ON OXIDATIVE STABILITY OF DIFFERENT OILS

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poster presentation

Over the last decade scientific studies on aromatization of plant-derived oils and potential prolongation of their shelf-life by the addition of natural plant extracts have increased exponentially.
This study investigated the chemical composition and oxidative stability of cold pressed and unrefined oils of hemp seed, flaxseed, sesame, and sunflower, as well as the effect of plant extract addition (balm, rosemary, winter savory, oregano, and lavender) on its stability. The oxidative stability of oils (3 g) without or with plant water extract additon (100 μL) was tested by Rancimat apparatus (20 L/h, 120 °C). The fatty acid profile of oils was analysed by gas chromatograph with FID detection Linoleic acid was the dominant fatty acid in all oils (range from 45 to 65%) except in flaxseed oil where high content of linolenic acid (50%) was detected. Among tested oils, sesame oil had the longest stability time (3.28 h) while most susceptible to oxidation was flax oil. The addition of balm, savory and oregano extracts in hemp seed and flax oil resulted with increased rate of their oxidation while in all other cases time of oil stability was prolonged. Especially good results were detected for lemon balm extract in case of sesame and sunflower oils, where 33 and 48% longer induction time was obtained.

Keywords: plant extracts, oil oxidative stability, Rancimat, fatty acid profile

PROCJENA UNOSA SOLI ODRASLE POPULACIJE U RH PRILIKOM KONZUMACIJE MLIJEČNIH I SNACK PROIZVODA

INTAKE ASSESSMENT OF SALT FOR ADULT POPULATION IN CROATIA BY CONSUMPTION OF DAIRY AND SNACK PRODUCTS

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poster presentation / postersko priopćenje

Naslanjajući se na *Znanstveno mišljenje o učinku smanjenog unosa kuhinjske soli u prehrani ljudi* Hrvatske agencije za hranu (HAH), na *Strateški plan za smanjenje prekomjernog unosa kuhinjske soli u RH 2015.-2019*. te na zaključke Radne skupine za definiranje Plana aktivnosti za 2015.-2019., razrađene su aktivnosti vezano uz smanjenje udjela kuhinjske soli u određenim grupama hrane. Ciljevi ovog plana su postupno smanjivati unos kuhinjske soli u općoj populaciji RH za prosječno 4 % godišnje, sa sadašnjih 11,6 g dnevno na 9,3 g do 2019. Određen udjel kuhinjske soli je nužan kako zbog tehnološkog procesa proizvodnje pojedinih proizvoda, tako i zbog okusa na koji je populacija naviknuta. Nakon provedenih aktivnosti vezanih za smanjenje udjela soli u kruhu te inicijativa nekih mesnih industrija oko smanjenja udjela soli u određenim mesnim proizvodima, HAH je načinio procjenu izloženosti za sljedeće dvije kategorije proizvoda obuhvaćene Strateškim planom: mlijeko i mliječni proizvodi te snack proizvodi. Podaci o potrošnji hrane u Hrvatskoj dobiveni su iz istraživanja koje je provela HAH tijekom 2011. i 2012., na nacionalnom, reprezentativnom uzorku po dobi, spolu i regiji, koje je obuhvatilo 2002 ispitanika u dobi od 18 do 64 godine. Metodološki, koristio se intervju „licem u lice“ i metoda 24-satnog prisjećanja, u trajanju od 3, a podaci o učestalosti potrošnje pojedine hrane dobiveni su putem Upitnika o učestalosti konzumacije. Podaci o količinama soli u pojedinim proizvodima očitani su direktno s deklaracija proizvoda. Procjenom izloženosti zaključeno je da unutar kategorije „mlijeko i mliječni proizvodi“, pojedinačni doprinos soli ukupnoj izloženosti nije značajan te obzirom na prosječnu konzumaciju te konačni doprinos, a proizvodi pogodni za reformulaciju bili bi polutvrdi i tvrdi sirevi te topljeni sirevi. U kategoriji snack proizvodi, unatoč nevelikom unosu, odnosno prosječnoj konzumaciji ovih proizvoda, doprinos ukupnom unosu soli je značajan, što ukazuje na potrebu za djelovanjem u pogledu reformulacije proizvoda te osvješćivanja javnosti po pitanju konzumacije ove vrste proizvoda.

Ključne riječi: smanjenje unosa soli, mliječni proizvodi, snack proizvodi

Keywords: salt reduction, dairy products, snack products

UTJECAJ MEHANIČKOG TRETMANA NA SMANJENJE IZDUŽIVANJA RASADA PAPRIKE

EFFECT OF MECHANICAL TREATMENT TO REDUCE ELONGATION OF PEPPER

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poster presentation / postersko priopćenje

Proizvodnja začinske paprike (*Capsicum annuum* L.) u istočnoj Hrvatskoj ima tradiciju dugi niz godina. Zbog neodgovarajućih agroekoloških uvjeta sije se u proljetnom periodu u plastenike ili klijališta, a oba načina imaju veliki nedostatak. Kod kasne proljetne sjetve u vrijeme nicanja i početnom porastu temperature variraju od - 1 °C do 20 °C, što u kombinaciji s niskom osvijetljenošću i visokom vlagom dovodi do izduživanje rasade koja je sklonija polijeganju, kontaminaciji patogenima, lomljenju i slabijem zametanja plodova. Jedan od načina rješavanja problema je moderniziranje plastenika i klijališta s boljim sustavima ventilacije, što je OPG-ima neisplativo zbog jednokratnih korištenja. Stoga bi se trebale iznaći metode koje bi iziskivale manje financijskog ulaganja. Jedna od mogućnosti je mehaničko tretiranje tj. „metlanje rasade“ tijekom dana u dva navrata, s ciljem smanjenja visine i bolje kondicije biljaka. Cilj ovoga rada bio je utvrditi utjecaj mehaničkog tretmana na rast rasade paprike. U pokusu je korišteno 6 uzoraka (3 slatkog tipa i 3 ljutog tipa) te je u svakom tipu bio zastupljen po jedan hibrid, sorta i lokalna populacija. Pokus je postavljen u dvoslojnom plasteniku u dvije repeticije u PVC plitice volumena 3,5 cm^2, te je po ponavljanju bilo zasijano 500 biljaka, a bilježene su minimalna i maksimalna temperatura zraka. Biljke su metlane tijekom dana u dva navrata u trajanju od 30 sekundi. Za analizu je uzeto po ponavljanju 25 slučajno odabranih biljaka bez vidljivih znakova bolesti i štetnika. Analizirana su svojstva visine biljke, debljina stabljike, broj listova, dužina i širina plojke. Utvrđene su razlike na nivou $P<0,05$ između tretiranih biljaka i kontrole za svojstvo visine biljke i broj listova, dok je svojstvo širina plojke imalo razliku samo između tipova uzoraka, a dužina plojke između vrsta unutar tipova. Tretirane biljke su u prosjeku bile niže za 10,2 mm (tretirane 109,6 mm; kontrolne 119,8 mm), dok su veći broj listova u prosjeku imale tretirane biljke (6,62) u odnosu na kontrolne (6,32).

Ključne riječi: paprika, plastenik, mehaničko tretiranje

Keywords: pepper, greenhouse, mechanical treatment

INSTANT PORRIDGE BASED ON THE EXTRUDED MIXTURES OF CORN GRITS AND BEAN FLOUR

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poster presentation

A modern life requires fast preparation of healthful and nutritionally valuable food. Therefore, instant food products are often used. In recent years, various instantiation techniques have been developed and it is possible to use different raw materials for instant food production. One of the relatively new technique is the extrusion process. The aim of this study was to produce extruded mixtures of corn grits and bean flour, and investigate the possibility of their application in production of instant porridge. The mixtures of corn grits and bean flour (70:30; 50:50 and 30:70 d.w.b.) with 17% of moisture content were extruded in laboratory single screw extruder Brabender 19/20 DN. After the extrusion, the samples were air-dried overnight at room temperature. Expansion ratio, bulk density and color of obtained extrudates were determined. For the production of instant porridge recipes three different mixtures of spices were used: salt, parsley, pepper, garlic (mixture 1); salt, *Vegeta*, pepper (mixture 2) and salt, celery, pepper, garlic (mixture 3). For the sensory evaluation, instant porridges were prepared with classic procedure of mixing in hot water. Analysis was performed by the panel of 6 trained panelists, and following attributes were rated: color, taste, smell, consistency and aftertaste.
The obtained results for the expansion ratio (ER) and bulk density (BD), as a important physical properties which are indirectly related to the degree of structure disturbance, showed that the addition of bean flour to corn grits resulted in decerease of ER and increase of BD. Furthemore, the addition of bean flour and extrusion process resulted in significant color change. By sensory evaluation it was found that the instant porridges based on the extruded mixture of corn:bean 30:70 had very high overall sensory score, where the porridge seasoned with mixture 3 of spices (salt, celery, pepper, garlic) is rated as the best porridge. Finally, it can be concluded the extrusion process can be successfully used for instantiation of corn grits:bean flour mixtures, which give a high sensory acceptable products with addition of different spice mixtures.

Keywords: instant products, extrusion, corn grits, bean flour

DOMESTIC HULLESS BARLEY AND MALT AS AN EASILY AVAILABLE SOURCE OF *β*-GLUCAN

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poster presentation

β-Glucans are described as non-starch polysaccharides, characterized by (1→3), (1→4) *β*-D-glucose linkage. In human nutrition, they are regarded as extremely wanted because of their bioactive and medicinal properties, because of their ability to lower cholesterol, regulate blood sugar, reduce the risk of heart disease and colon cancer. Especially desirable are (1,3)-*β*-D-glucans because they act as immunomodulatory agents. The aim of this paper was to determine the mass fraction of *β*-glucans and the ratio of total and soluble *β*-glucans in barley and malt in domestic hulles barley varieties. Hulles barley is an accesible and cheap source of β-glucans. Four different domestic varieties of hulles barley obtained from the Agricultural Institute Osijek were examined in this research. The results indicate that all tested varieties have higher *β*-glucans content than standard winter and spring varietes. Variety Matko showed close relation, with 500 mg/L in malt, to the EFSA (European Food Safety Authority) health inpiring recommendations of 3 g of soluble *β*-glucans per serving.

Keywords: croatian hulles barley varieties, β-glucan content, solubility of β-glucan

THE INFLUENCE OF PROPOLIS AND/OR BEE POLLEN SUPPLEMENTATION ON THE CHICKEN MEAT QUALITY

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poster presentation

The aim of this study was to determine the influence of dietary supplementation with propolis and/or bee pollen on the chicken meat quality evaluated through breast muscle pH value measured 45 minutes (pH_1) and 24 hours *post mortem* (pH_2), drip loss of the breast muscle and its color (L*, a*, b*). The study was conducted on 200 Ross 308 chickens equally distributed by sex and divided into five groups. Throughout the whole study, the control group of chickens was fed with a basal diet, while the experimental groups of chickens were fed with the same diet supplemented with propolis and/or bee pollen, each supplement given separately or in combination in a certain proportion. The study showed that there were no statistically significant differences between control group and experimental groups of chickens considering pH_1 (p=0.567) and pH_2 (p=0.153), while there was statistically significant difference between groups considering drip loss (p=0.003). Study further revealed that there was statistically significant difference in b* breast muscle color (p<0.001) between control group and experimental groups of chickens while there were no statistically significant differences in L* and a* breast muscle color (p=0.482 and p=0.319, respectively). Tested supplementation has positive influence on chicken meat quality.

Keywords: propolis, bee pollen, chicken breast meat, chicken feeding

PROIZVODNJA HLADNO PREŠANOG SEZAMOVOG ULJA

THE PRODUCTION OF COLD-PRESSED SESAME OIL

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poster presentation / postersko priopćenje

Postupkom hladnog prešanja iz sjemenki sezama (*Sesamum indicum* L.) dobije se jestivo ulje visoke nutritivne vrijednosti. U sezamovom ulju dominiraju oleinska i linolna masna kiselina u podjednakim udjelima. Prisutnost fenolnih antioksidanasa sezamina i sezamolina osigurava odličnu otpornost ulja prema oksidacijskom kvarenju. Cilj ovog rada bio je ispitati utjecaj kondicioniranja sjemenke sezama na iskorištenje ulja tijekom prešanja s kontinuiranom pužnom prešom. Također je ispitan i utjecaj dodatka ljuske suncokreta u sjemenke sezama na efikasnost proizvodnje sirovog ulja i hladno prešanog ulja. Primjenom standardnih metoda u sezamovom ulju određeni su osnovni parametri kvalitete (peroksidni broj, slobodne masne kiseline, udio vode i netopljivih nečistoća). Rezultati ispitivanja pokazuju da kondicioniranje i dodatak ljuske suncokreta utječu na iskorištenje sezamovog ulja. Prastom temperature kondicioniranja sezama, kao i udjela ljuske suncokreta ostvarena je veća proizvodnja sezamovog ulja.

Ključne riječi: sezamovo ulje, prešanje, kondicioniranje, ljuska suncokreta

Keywords: sesame oil, pressing, conditioning, sunflower shell

DRIJEN - ZABORAVLJENI IZVOR

CORNELIAN CHERRY - FORGOTEN SOURCE

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oral presentation / usmeno priopćenje

Drijen ili drijenak (*Cornus mas* L.) ili narodnim imenom drenjina je samonikli grm ili niže stablo iz porodice drijenovka (*Cornaceae*). Naziv dolazi od latinske riječi *cornu* što znači rog i *mas* što znači muški. Eko zemljopisni areal rasprostranjenosti ovog samoniklog voća je veoma širok, a proteže se kroz područje cijele Euroazije. Od davnine su poznata njegova, u moderno vrijeme zaboravljena i zapostavljena ljekovita svojstva. Crveni, mesnati bobičasti plodovi veličine do 1,5 cm dozrijavaju u kolovozu i rujnu. Sirovi ekstrakt ovog voća i drugih dijelova biljke i njihovi čisti izolati pokazuju široki spektar farmakoloških aktivnosti kao što su antimikrobiološki, antidijabetički, antiarterosklerotični učinak kao i citološki, hepato, neuro i nefro protektični učinak, te antitrombocitne i antiglaukomne aktivnosti. Antocijani, flavonoidi, iridoidi i vitamin C glavni su bioaktivni sastojci plodova kao i prisutni minerali, poglavito željezo. Pripravci od ovog voća na studijama akutne toksičnosti na životinjskim i humanim modelima pokazali su se sigurnim. Klinička ispitivanja kod dijabetesa tipa2 i bolesnika s hiperlipidemijom pokazala su značajne trendove poboljšanja razine glukoze u krvi, lučenja inzulina u bolesnika s dijabetesom i poboljšanja lipidnog profila, statusa apolipoproteina i upalnih krvožilnih bolesti kod hiperlipidemičnih bolesnika. Ekonomska vrijednost ove voćne vrste nije dovoljno iskorištena u komercijalne svrhe, kao potencijalne sirovine za farmaceutsku, prerađivačku i kozmetičku industriju. Danas se plodovi drijenka uglavnom koriste za vlastitu potrošnju u obiteljskim gospodarstvima, a nedavno je u Republici Hrvatskoj registriran i prvi proizvod od drijenka s odobrenom zdravstvenom tvrdnjom.

Ključne riječi: drijen, antocijani, sigurnost, hrana

Keywords: cornelian cherry, anthocyanins, safety, food

MOGUĆNOST PROIZVODNJE ZDRAVSTVENO SIGURNE HRANE U TLIMA ONEČIŠĆENIM MANGANOM

MANGANESE POLLUTION IN AGRICULTURAL SOILS WITH IMPLICATIONS FOR FOOD SAFETY

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oral presentation / usmeno priopćenje

Mangan (Mn) je esencijalni element za biljku i neophodan za provođenje niza fizioloških procesa, u prvom redu fotosinteze, ali njegov veći sadržaj u tlu može imati štetan učinak na biljku, a posljedično i na čovjeka. Shodno navedenome, s gledišta proizvodnje zdravstveno sigurne hrane od velike je važnosti utvrditi sadržaj Mn u jestivim dijelovima biljke uzgajanim na tlima u blizini ležišta manganove rude.

Cilj ovog istraživanja je bio ispitati sadržaj ukupnih i pristupačnih oblika Mn u tlima smještenim u neposrednoj blizini dvaju ležišta manganove rude na području općine Bužim, te utvrditi akumulaciju Mn u jestivim dijelovima poljoprivrednih kultura koje se na tim tlima u većoj mjeri uzgajaju. Sadržaj Mn u ispitivanim uzorcima tla i biljki određen je metodom atomske apsorpcijske spektrofotometrije.

Sadržaj ukupnih oblika Mn u svim tlima na ispitivanim lokalitetima je bio visok i prelazio je vrijednost od 1000 $mgkg^{-1}$ suhe tvari, koja se u znanstvenim krugovima uzima kao granična interventna vrijednost za sadržaj Mn u tlu. Neovisno o navedenome, utvrđeni sadržaj Mn u jestivim dijelovima svih ispitivanih biljaka nije prelazio graničnu vrijednost za sadržaj Mn u biljci, što upućuje na zaključak da proizvodnja zdravstveno sigurne hrane na ispitivanim lokalitetima, glede onečišćenja tla manganom, ne bi trebala biti upitna.

Ključne riječi: rudnik, poljoprivreda, voće, povrće, zdravlje

Keywords: mine, agriculture, fruits, vegetables, health

PRIMJENA 3D PRINTANJA U PROIZVODNJI FUNKCIONALNE HRANE

APPLICATION OF 3D TECHNOLOGY FOR FUNCTIONAL FOOD PRINTING

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oral presentation / usmeno priopćenje

Trodimenzionalno printanje („3D printing“) podrazumijeva proizvodne procese koji se primjenjuju s ciljem stvaranja trodimenzionalnih objekata što prehrambenoj industriji omogućuje korištenje većeg broja sirovina te poboljšanje izgleda i teksture tradicionalnih proizvoda kontrolom prehrambenih materijala na mikro- i makro-strukturnoj razini. Funkcionalna hrana se nameće kao novo polje razvoja 3D printanja u prehrambenoj industriji, jer se slaganjem posebnih receptura prilagođenih osobnim prehrambenim potrebama pojedinca razvija se i nova grana personalizirane prehrane.
Zbog mogućnosti stvaranja različitih oblika, te prilagođene recepture 3D printane namirnice su praktične za konzumaciju te primjerene za specijaliziranu prehranu vojnika, astronauta, te osoba s posebnim prehrambenim zahtjevima ili poteškoćama u žvakanju i gutanju (starije osobe kojima često nedostaje raznovrsne prehrane, bolesnicima, trudnicama i maloj djeci). Jedna od glavnih prednosti ove tehnologije je smanjenje proizvedenog otpada u proizvodnji hrane, kao i maksimalno iskorištavanje sirovina te mogućnost proizvodnje jestive ambalaže i pribora za jelo. Prema dosadašnjim istraživanjima tehnologija 3D printanja hrane ima sve predispozicije za stvaranje ekološki prihvatljivih i održivih prehrambenih navika.

Ključne riječi: 3D printanje, funkcionalna hrana, perosnalizirana prehrana

Keywords: 3D printing, functional food, peroznalized diet

SCIENTIFIC SEMINAR:
"OLIVE OIL AS A FUNCTIONAL FOOD" /
ZNANSTVENI SEMINAR:
„MASLINOVO ULJE KAO FUNKCIONALNA HRANA"

PHENOLIC CHARACTERIZATION OF EXTRA VIRGIN OLIVE OIL FROM CROATIA

Tea Bilušić*

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invited lecture

In the field of olive oil production, the potential of Croatian autochthonous cultivars is poorly investigated. According to archeological findings, the beginnings of olive growing in Dalmatia date back to the late Bronze Age. In spite of this long tradition of olive oil production in Dalmatia, according to available literature, there is no data on phenolics secoiridoids content in Croatian extra virgin olive oils. 1H NMR method was used to determine phenolic composition of extra virgin olive oil collected during harvesting period from 2016 to 2017 in Croatia. Collection of olive oil samples from more than 100 olive oil producers included several Croatian regions: Istra and Kvarner, Primorje region, Split-Dalmatia County, Dubrovnik-Neretva County, Zadar and Šibenik County. One of the main objectives of this project was to investigate potentials of production of high phenolic olive oils that on the global market can be characterized as functional food according to EU legislative (432/2012) approved by EFSA about the effect of olive oil phenolics on the prevention of cardiovascular diseases.
In addition, phenolic characterization from selected Croatian autochthonous olive cultivars (*Drobnica*, *Oblica*, *Buhavica*, and *Lastovka*) were done in relation to harvest period (early and late) and their oxidative stability was evaluated. Obtained results showed that Croatian extra virgin olive oils are very rich with phenolic compounds and that Croatia has a high potential to produce high phenolic olive oils with health claim.

Keywords: extra virgin olive oil, Croatia, phenolic profile

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ENCAPSULATION TECHNIQUES OF NATURAL BIOACTIVE COMPOUNDS

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invited lecture

Nowadays, the food industry expects complex properties from food ingredients such as stability, thermal protection, sustained release, and suitable sensorial properties. This would not be able to achieve without microencapsulation. In this review the cutting edge encapsulation technology for delivery of bioactive compounds to food is presented. Common encapsulation technologies versus novel and interesting approaches in emerging technologies are reviewed. It is well known that spray drying has been used for many years to protect flavor oils against degradation/oxidation/evaporation, but melt dispersion technique has been used lately to effectively stabilize an aroma compound. Microparticles produced by extrusion and emulsification techniques are considered for delivering synergistic antioxidant effects of plant extract polyphenols, their off-taste masking, and improved handling. In addition to microgels, microemulsions are taken into account for entrapment of extracts containing polyphenols and essential oils. New and attention-grabbing coacervation processes are also interesting topic as they facilitate the commercialization of coacervated food ingredients. Furthermore, liposomes are gaining growing attention in the food sector as they can provide good stability even in a water surrounding. Thus, the novel industrial procedures for the production of liposomes developed in recent years are attractive for discussion. Fluidized bed technology has been offering a versatile possibility to produce encapsulates which should release ingredients at the right place and the right time. Finally, complex systems such as lipids in hydrogels are newly developed structures for controlled release of different bioactive compounds.

Keywords: encapsulation, food industry, bioactive compounds

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OLIVE OIL AS NATURAL SOURCE OF PHENOLIC COMPOUNDS

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invited lecture

In comparison to other plant-derived oils, extra-virgin olive oil production includes only mechanical processes without any refining, and due to its specific chemical composition olive oils are already recognized as a natural functional food. Beside well-balanced fatty acid profile, the presence of minor constituents, such as phenolics, tocopherols and sterols, is found to be responsible for its health benefits. Olive oil chemical composition is affected by a great number of factors among which the most important are cultivar, environmental conditions, crop management, maturity stage of the fruit and oil extraction conditions. Olive oils can be differentiated from other vegetable oils due to its specific phenolic composition and high content of phenolics (50-1000 mg/kg). The major phenolics in olives and olive oils are phenolic alcohols (hydroxytyrosol and tyrosol), phenolic acids, secoiridoids, flavonoids, lignans, etc. As these compounds affect the organoleptic characteristics of the oil and increase its oxidative stability, their extraction and preservation is crucial for the overall quality of the final products.

Keywords: olive oil, minor components, phenolic compounds, biologically active constituents

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PHENOLIC SECOIRIDOIDS FROM EXTRA VIRGIN OLIVE OIL AND OLIVE OIL - HEALTH CLAIM

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invited lecture

The Mediterranean-diet is characterized by a unique combination of bioactive healthy ingredients coming from olive oil. Olive oil is not only a source of healthy unsaturated lipids but it also contains unique fine chemicals belonging to the class of secoiridoid phenolics and especially compounds like oleocanthal and oleacein which present very important pharmacological properties. A big number of recent clinical and experimental trials of high phenolic olive oil about cardiovascular diseases, neurodegenerative diseases, cancer, inflammation, hypertension and hyperlipidemia have been performed the last years and new methods for their quantitative measurement related to the certification of the EU health claim have been developed based on qNMR and LC-MS/MS and colorimetric reactions.
New bioactive olive oil ingredients like oleokoronal, oleomissional oleocanthalic acid and elenolide have been discovered revealing the chemical diversity of olive oil ingredients.
The phenolic profile of the olive oil has been found to be dependent on several factors and especially the olive variety, the maturity during harvest and the process followed in the olive mill.
In the framework of the ARISTOIL project we have performed several experiments to investigate the effect of malaxation time and temperature to the secoiridoid phenolics. For most studied varieties, the transformation of oleomissional and oleokoronal to oleacein and oleocanthal respectively, increases at higher malaxation time and temperature and optimum parameters have been established for the production of high phenolic olive oils with health claim.

Keywords: olive oils, phenolic profile, health claim

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THE EFFECT OF OLIVE FRUIT MATURITY, MALAXATION TEMPERATURE AND MALAXATION TIME IN THE CONCENTRATION OF SPECIFIC PHENOLS IN EXTRA VIRGIN OLIVE OIL

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poster presentation

Secoiridoid phenolic derivatives are one of the most important classes of constituents in olive oil which present an increasing potential for health protection. The main factors that affect the phenolic concentration are the ripening degree, the olive fruit variety, malaxation time and temperature. Many researchers suggest that total phenols decrease as the ripening degree grows and others suggest that there is an increase of the total phenols in the early ripening degree followed by a decrease. Malaxation temperature seems to be a controversial factor. For most of researchers malaxation time seems to be negatively correlated with the concentration of the phenolic compounds.
In order to investigate in-depth the above factors we performed olive oil extraction at six different ripening stages (October to February), three different temperatures (22, 28 and 32 °C) and five different malaxation times (15, 30, 45, 60, 90 min) for two important Greek varieties (Koroneiki and Athinolia). Based on NMR analysis we were able to quantify each phenolic compound in each experiment (oleocanthal, oleacein, oleuropein aglycons, ligstroside aglycons, oleokoronal and oleomissional). Total phenols were found to be negatively affected by the ripening degree especially in the late ripening. The general trend was that total phenolic compounds decrease during malaxation with the highest concentration always observed at the first time point of 15 min. Malaxation temperature seems to be a crucial factor for the concentration of phenols. Even a small increase of temperature enhanced the formation of total phenols. Higher temperature in most cases also enhanced the formation of oleocanthal and oleacein when malaxation lasted 30 to 45 minutes. We clearly observed that during malaxation, oleokoronal and oleomissional are transformed to oleocanthal and oleacein due to specific enzymes with demethylase activity. The performance of this transformation seems to be different in each variety.

Keywords: phenolic compounds, virgin olive oil, maturity, malaxation time and temperature

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ELENOLIDE: A NEW CONSTITUENT OF EXTRA VIRGIN OLIVE OIL

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poster presentation

Extra Virgin Olive Oil is a food with an officially recognized health claim in the EU. It contains health protecting ingredients belonging to secoiridoids, such as derivatives of oleuropein and ligstroside. The already known derivatives are conjugated secoiridoid phenols, such as oleocanthal, oleacein, oleuropein aglycons, ligstroside aglycons, oleomissional and oleokoronal. Based on NMR analysis of olive oil, we observed for the first time that most olive oils with high phenolic content contain also significant quantities of another potential beneficial ingredient: elenolide, which is the subject of the current study. Elenolide is a non-phenolic derivative of oleuropein and ligstroside aglycon. Elenolide is a new important substance of olive oil because of its potential antihypertensive activity which had been patented in the 60's as an ingredient isolated from olive leaves and olive fruit juice or chemically synthesized.
Elenolide was isolated from olive oil and its structure was elucidated using 1D and 2D NMR (Nuclear Magnetic Resonance) and GC/MS (Gas Chromatography-Mass Spectrometry). It is the first time that the structure of elenolide is characterized by NMR. In addition, we developed a method of quantitative measurement based on qNMR. Investigation of 2120 olive oil samples from the most well-known varieties showed that elenolide was present in the majority of samples in quantities ranging from 0 to 2821 mg/kg. Although the presence of a hydrated derivative of elenolide (elenolic acid) had been reported as an olive oil ingredient, it is the first time herein that elenolide is proved to be artificially transformed to elenolic acid during usual chromatography in aqueous media. Finally, it was found that the quantity of elenolide in olive oils depends on the quantity of the used water during the procedure of malaxation and could be used as marker of high quality oils with low water content.

Keywords: elenolide, extra virgin olive oil, NMR, GC/MS

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Pripremljena na pravi način, riba predstavlja vrhunski gastronomski doživljaj u kojem možete uživati tijekom cijele godine uz široku ponudu Ledo smrznute ribe. Zamrzavanje svježe ribe strogo je kontrolirani proces koji tehnologijom brzog zamrzavanja omogućava Ledo ribi iz divljeg ulova zadržavanje svih vrijednih nutrijenata. Širok asortiman Ledo ribe omogućit će Vam jednostavnu i brzu pripremu jela koja će se svidjeti svima. Sve što trebate učiniti je iz Ledo škrinje odabrati ribu po svom ukusu. Za dodatne ideje kojima možete zadiviti svoje najmilije zavirite na stranicu recepti.ledo.hr te se inspirirajte jednostavnim i ukusnim receptima.

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