Food industry by-products : book of abstracts : 3rd International Scientific and Professional Conference FOOD INDUSTRY BY-PRODUCTS

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SIDE STREAMS FROM FOOD PROCESSING INTO NEW FOOD AND FEED – A CIRCULAR BIOECONOMY APPROACH

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plenary lecture

Improved utilizing of food resources is an important contribution for future food supply to the growing world population. The food resources are limited and a circular approach to food and nutrient utilization is needed. Valuable nutrients are lost throughout the value chains on the way to becoming food. This may be food loss and food waste, that are resources intended to be food in the first place. However, it may also be side-streams or residual raw materials that are valuable resources that can become ingredients in food or feed if handled and processed the right way. These resources can be upgraded to e.g., future protein and lipid sources for human and animal nutrition. This presentation will include (1) examples of new utilization of side streams from different food value chains, (2) different enabling technologies and (3) some regulatory aspects concerning the use of new ingredients from processing side streams into food or feed.

Keywords: Research utilisation, side-streams, residual raw materials, valorisation, circular economy

ByProExtract - PRIMJENA INOVATIVNIH TEHNIKA EKSTRAKCIJE BIOAKTIVNIH KOMPONENTI IZ NUSPROIZVODA BILJNOGA PODRIJETLA

Stela Jokić*

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plenarno predavanje

Tijekom prerade sirovine nastaje određena količina nusproizvoda koji nužno ne moraju biti otpad i "problem" nego visokovrijedna sirovina za razvoj novih proizvoda. Kakao ljuska, otpad iz proizvodnje duhana i kore citrusa su nusproizvodi koji nastaju u velikim količinama i koji su još uvijek nedovoljno istraženi i iskorišteni unatoč sadržaju značajnih korisnih tvari. Cilj ovog projekta je proizvodnja ekstrakata iz navedenih nusprozvoda primjenom šest inovativnih zelenih ekstrakcijskih tehnika: superkritične CO_2 ekstrakcije, ekstrakcije vodom u supkritičnom stanju, ekstrakcije potpomognute mikrovalovima, ekstrakcije potpomognute ultrazvukom, ekstrakcije potpomognute hladnom plazmom i ekstrakcije eutektičnim otapalima. U određivanju ciljanih bioaktivnih komponenti iz odabranih nusproizvoda primjenile su se visokosofisticirane kromatografske tehnike. Zbog velike raznolikosti bioaktivnih komponenti iz odabranih nusproizvoda, za svaku primijenjenu tehniku ekstrakcije definirali su se optimalni procesni parametri primjenom metode odzivnih površina. Ekstrakti s najvećim biološkim potencijalom postupkom sušenja raspršivanjem preveli su se u praškasti oblik s potencijalnom komercijalnom primjenom.
Rezultati istraživanja doprinose potencijalnom rješenju problema velikih količina organskog otpada koji predstavlja ogroman ekološki i financijski teret u svim segmentima procesne industrije. Naglasak projekta je na potencijalnoj komercijalnoj valorizaciji rezultata istraživanja i transferu dobivenih rezultata u industriju, kao i na jačanju veze akademske zajednice s industrijom s ciljem ekonomskog razvoja i boljitka cijelog društva. Kroz petogodišnje razdoblje trajanja projekta obranjene su 3 doktorske disertacije, te je publicirano 6 poglavlja u knjigama, 34 znanstvena rada (većinom Q1/Q2 kvartil) uz 45 sudjelovanja na međunarodnim skupovima.

Ključne riječi: nusproizvodi, inovativne ekstrakcijske tehnike, bioaktivne komponente

Ovaj rad je sufinancirala Hrvatska zaklada za znanost projektom "Primjena inovativnih tehnika ekstrakcije bioaktivnih komponenti iz nusproizvoda biljnoga podrijetla" (UIP-2017-05-9909).

ByProExtract - APPLICATION OF INNOVATIVE TECHNIQUES OF THE EXTRACTION OF BIOACTIVE COMPONENTS FROM BY-PRODUCTS OF PLANT ORIGIN

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plenary lecture

During the processing of raw materials, a certain amount of by-products is produced, which does not necessarily have to be "waste", but a by-product or high value raw material for development of new products. Cocoa shells, tobacco waste, and citrus peels, are by-products produced in large quantities which are usually underutilized or considered as waste, in spite of the fact that they contain different classes of useful components. The aim of this project is to obtain extracts rich in bioactive components from selected by-products using six innovative green extraction techniques: supercritical CO_2 extraction (SC-CO_2), subcritical water extraction (SWE), microwave-assisted extraction (MAE), ultrasound-assisted extraction (UAE), cold atmospheric plasma assisted extraction (CAPAE), and extraction using deep eutectic solvents (DES). Determination and isolation of bioactive components from selected by-products were performed using highly sophisticated chromatographic techniques. Due to great diversity of bioactive components from diverse material, optimal extraction conditions were defined for each applied technique by using response surface methodology (RSM). Extracts with the highest biological potential had been dried by using spray drying technology in order to produce plant powders with potential commercial application.

The results of the research contribute to solving the problem of large quantities of organic waste, which represents an enormous ecological and financial burden for all aspects of the process industry. Special emphasis in the project was on the possible commercial valorisation of the research results and on the transfer of those results to the application level, as well as on strengthening the relationship between the academic community and the industry, developing the economy, and creating a positive social impact. During the five-year period of the project duration, 3 doctoral dissertations were defended, 6 book chapters and 34 scientific papers (mostly Q1 / Q2 quartiles) were published with 45 participations in international conferences

Keywords: byproducts, innovative extraction techniques,bioactive compounds

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

RAZVOJ INOVATIVNIH PROIZVODA OD NUSPROIZVODA TIJEKOM PRERADE POVRĆA

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plenarno predavanje

Tijekom prerade voća i povrća, 10-35% mase sirovog materijala se odbacuje. Odbačeni dijelovi su sjemenke, pulpa, peteljke, kožica ili komina. Najčešće se se taj biološki otpad koristi za prehranu životinja ili za proizvodnju bioplina, humusa i sl. U preradi paprike (*Capsicum annuum L.*) do gotovog prehrambenog proizvoda (prilozi, namazi, umaci), oko 15-18% mase paprike otpada na odbačeni, premda nutritivno vrijedni resurs: sjemenka (2-3 %) i sjemena loža (9-13 %). U dvogodišnjem istraživanju (2020.-2022.), analizirana je sjemenka paprike sorti Podravka i Slavonka, kao i njezin potencijal za razvoj novih proizvoda. Sjemenka paprike je bogata dijetalnim vlaknima (47-57 %) i bjelančevinama (17-18 %), a dokazana je i prisutnost fenola (ukupni fenoli 179-247 mg GAE /100g). Udio ulja u sjemenki paprike iznosi 25-31 %, te su primjenjena dva postupka ekstrakcije ulja: hladno prešanje i suprekritičnom CO_2. Ekonomski isplativije, ulje sjemenki paprike dobiveno hladnim prešanjem, je narančasto-crvene boje, ugodnog okusa i mirisa, bogato omega-6 masnom kiselinom (linolna: 73-75 %), vitaminom E (γ-tokoferol 53-59 mg/100 g), te sadrži polifenolne spojeve i flavonoide. Pogača koja zaostaje nakon hladnog prešanja sjemenki paprike, također je bogata dijetalnim vlaknima (50-52 %) i bjelančevinama (oko 20-24 %), a osušena i mljevena kao brašno, može se upotrijebiti kao sastojak u razvoju novih prehrambenih i/ili neprehrambenih proizvoda, više dodane vrijednosti. Rezultati projekta stvarili su solidne temeljne za daljnju transformaciju iz linerane u kružnu bioekonomiju, u skladu sa 17 održivih razvojnih ciljeva UN-a.

Ključne riječi: nusproizvodi, povrće, paprika, funkcionalni proizvodi, kružna bioekonomija

DEVELOPMENT OF INNOVATIVE PRODUCTS FROM BY-PRODUCTS DURING VEGETABLE PROCESSING

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plenary lecture

During the processing of fruits and vegetables, 10-35% of the mass of raw materials are discarded. Discarded parts are seeds, pulp, stalks, skins or pomace. Most often, this biological waste is used for feeding animals or for the production of biogas, humus, etc. In the processing of peppers (*Capsicum annuum* L.) into finished food products (side dishes, spreads, sauces), about 15-18% of the mass of peppers is discarded, although nutritionally valuable resource: seeds (2-3%) and seed lodge (9-13%). In a two-year study (2020-2022), pepper seeds of the Podravka and Slavonka varieties were analyzed, as well as their potential for the development of new products. Pepper seeds are rich in dietary fibers (47-57%) and proteins (17-18%), and the presence of phenols has been proven (total phenols 179-247 mg GAE /100g). The content of oil in pepper seeds is 25-31%. Consequently, two oil extraction procedures are used: cold pressing and supercritical CO_2. Economically more profitable, pepper seed oil obtained by cold pressing, is orange-red color, has a pleasant taste and smell, rich in omega-6 fatty acid (linoleic fatty acid: 73-75%), vitamin E (γ-tocopherol 53-59 mg/100 g), and contains polyphenol compounds and flavonoids. The cake (pomace) that remains after the cold pressing of the pepper seeds is also rich in dietary fiber (50-52%) and proteins (about 20-24%), and when dried and ground as flour, it can be used as an ingredient in the development of new food and/or non-food products, higher added value. The results of the project created a solid foundation for further transformation from a linear to a circular bioeconomy, in accordance with the United Nations 17 sustainable development goals.

Keywords: by-products, vegetables, peppers, functional products, circular bioeconomy

INVITED LECTURES /
POZVANA PREDAVANJA

GRAPE MARC AS A SOURCE OF BIOACTIVE COMPOUNDS - EXTRACTION, CHARACTERIZATION AND APPLICATIONS

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invited lecture

It is estimated that a surface of 3,000M of hectares is occupied by vineyards worldwide. About 80% of the total amount is used in wine making, and during wine production, approximately 25% of the grape weight results in a residue, called 'marc'. Its excessive accumulation causes a seasonal management and environmnetal problem.
In last years, the availability of modern analysis technologies along with the 'Green Chemistry' principles, allow the effective reuse of agri-food by-products by producing value-added products. Due to the characteristics of white wines vinification, the grape marc generated during winemaking is very rich in polyphenols, keeping most of the original polyphenolic load of the grapes.
The main objective of this work is the obtention of white grape marc extracts rich in bioactive compounds to produce natural antimicrobial and antioxidant high value products. For this purpose, an environmentally-friendly procedure based on Medium-scale Ambient Temperature Systems (MSATs) is proposed. This configuration easily allows the further scale-up to pre-industrial production. MSTAs meet the green analytical chemistry (GAC) principles. Different generally recognized as safe (GRAS) solvents were tested to modulate the bioactive compounds profile. The obtained extracts were deeply characterized in terms of total polyphenolic content (TPC) and antioxidant capacity. Liquid chromatography-tandem mass spectrometry (LC-MS/MS) was also employed to quantify individual phenolic compounds. Results revealed the presence of a high number of bioactive compounds up to hundreds of mg L^{-1}. The extracts also poseess a high antimicrobial activity against different pathogens. The last goal of this work is to provide effective complements and/or alternatives to the main antibiotics used in farmed animals through the use of more affordable natural functional products from alternative sources.

Keywords: grape marc, bioactive compounds, polyphenols, green chemistry, circular economy

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KVALITETA I PRIMJENA PČELINJEG VOSKA U INDUSTRIJI

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pozvano predavanje

Vosak je proizvod mladih pčela radilica i one ga sintetiziraju u trbušnim žlijezdama, a zatim koriste za formiranje satnih stanica. Prerađuje se i regenerira topljenjem saća, a nakon ekstrakcije meda danas je vrlo čest problem patvorenja dodavanjem parafina, loja, biljnog voska i sl.
Kvaliteta voska je definirana njegovim kemijskim sastavom, fizikalnim, biološkim i organoleptičkim svojstvima. Kemijski sastav mu je složen i čine ga voštane i nevoštane komponente. Strukturu čine: esteri, hidroksi esteri, kiseli esteri, kiseli poliesteri, ugljikovodici, slobodne kiseline i alkoholi te ostali sastojci. Vosak može biti kontamiran perzistentnim kontaminantima koji su uglavnom topljivi u mastima. To su prije svega lipofilni akaricidi, a u posljednje vrijeme izučavaju se i zagađenja iz okoline. Značajnija fizikalna svojstva voska su: točka topljenja, specifična težina, tvrdoća, elastičnost, boja, miris i dr. Točka topljenja se nalazi u temperaturnom rasponu od 62 °C do 64 °C, a indeks refrakcije na 75 °C se kreće od 1,440 do 1,445 i ovi parametri su čest pokazatelj patvorenja.
Smatra se univerzalnom sirovinom, jer se može koristiti za oko 2000 različitih namjena. Osim u pčelarstvu, gdje se koristi za izradu satnih osnova, nalazi veliku primjenu i u drugim industrijskim granama, pa je potražnja za njim posljednih godina u značajnom porastu.
Poznavanje kemije pčelinjeg voska je osnova za unaprijeđenje njegove kvalitete, kao i sprječavanje patvorenja. Kvaliteta se kontrolira standardiziranim senzorskim i kemijskim analizama. Vosak se često patvori, pa je potrebna kvalitetna metodologija njegove kontrole, ispitivanje porijekla i sprječavanje patvorenja.

Ključne riječi: vosak, kvaliteta, standardizacija, primjena voska, patvorenje voska

QUALITY AND APPLICATION OF BEESWAX IN INDUSTRY

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invited lecture

Wax is a product of young worker bees and they synthesize it in the abdominal glands and then use it to form honeycomb. It is processed and regenerated by melting honeycombs, and after honey extraction, today it is a very common problem of counterfeiting by adding paraffin, tallow, vegetable wax, etc.
Wax quality is defined by its chemical composition, physical, biological and organoleptic properties. Its chemical composition is complex and consists of waxy and non-waxy components. The structure consists of: esters, hydroxy esters, acid esters, acid polyesters, hydrocarbons, free acids and alcohols and other ingredients. Wax can be contaminated with persistent contaminants that are mostly soluble in fats. These are primarily lipophilic acaricides, and recently environmental pollution has also been studied. Significant physical properties of wax are: melting point, specific gravity, hardness, color elasticity, odor, etc. The melting point is in the temperature range from 62 ° C to 64 ° C, and the refractive index at 75 ° C ranges from 1,440 to 1,445 and these parameters are a common indicator of forgery.
It is considered a universal raw material because it can be used for about 2000 different purposes. Apart from beekeeping, where it is used to make hourly bases, it is also widely used in other industries, so the demand for it has increased significantly in recent years.
Knowledge of the chemistry of beeswax is the basis to improve its quality, as well as prevent forgery. Quality is controlled by standardized sensory and chemical analyses. Wax is often counterfeited, so a quality methodology of its control, examination of origin and prevention of counterfeiting is needed.

Keywords: wax, quality, standardization, wax application, wax counterfeiting

INOVATIVNA RJEŠENJA ZA OTPAD OD HRANE

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pozvano predavanje

Otpad od hrane nastaje u svakoj fazi proizvodnog ciklusa – od farme preko distribucije i maloprodaje do kupaca. Valorizacija otpada od hrane odnosno nusproizvoda prehrambene industrije postala je jedan od glavnih predmeta istraživanja za poboljšanje održivosti prehrambenog lanca. Danas je veličina globalnog tržišta proizvoda od otpada od hrane procijenjena na 52,91 milijardu USD, a prema CAGR-u (kombinirana godišnja stopa rasta) predviđa se da će rasti 4,6% i tako doseći 83,26 milijardi USD do 2032. Cilj ovoga rada je dati pregled aktualnih trendova u korištenju otpada odnosno nusproizvoda hrane za poboljšanje finalnih prehrambenih proizvoda i proizvodnje inovativnih proizvoda kao i novih tehnologija koje se koriste za dobivanje visoko vrijednih molekula. Korištenje određene metodologije za ekstrakciju bioaktivnih spojeva iz nusproizvoda hrane ovisi o njihovom izvoru, kemijskim svojstvima, funkcionalnosti i krajnjoj upotrebi. Neke od glavnih tehnika ekstrakcije koje se koriste su ekstrakcija uz pomoć mikrovalova, ekstrakcija superkritičnim fluidima, ekstrakcija pulsirajućim električnim poljem itd. Tako dobiveni bioaktivni spojevi danas se često koriste za proizvodnju različitih, funkcionalnih i nutritivnih prehrambenih proizvoda kao što su bez glutenski krekeri, sladoled, kruh, jogurt, sir, voćni pire, snack bar itd. No, nusproizvodi hrane mogu se koristiti i za proizvodnju nekih neprehrambenih inovativnih proizvoda poput majica izrađenih uz pomoć proteina kiselog mlijeka, posude za hranu napravljene od taloga i ljuske kave ili dijelova automobila napravljenih od otpada od hrane.

Ključne riječi: otpad od hrane, bioaktivne tvari, valorizacija nusproizvoda od hrane, iskorištenje nusproizvoda od hrane

INNOVATIVE SOLUTIONS TO FOOD WASTE

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invited lecture

Food waste is created at every stage in the production cycle – from farm through distribution and retail to customer. The valorisation of food wastes and by-products has become a major subject of research to improve the sustainability of the food chain. Today the global products from food waste market size is valued at USD 52.91 billion, and is projected to grow at a CAGR (the compound annual growth rate) of 4.6% to reach USD 83.26 billion by 2032. This review will provide an overview of the current trends in the use of food by-products for improving human nutrition and production of innovative products as well as the methodologies employed for the recovery of highly valued molecules. The use of certain methodology for the extraction of bioactive compounds from food by-product depends on their source, chemical properties, functionality, and end-use. Some of the major extraction techniques that are used are microwave-assisted extraction, sub-critical water extraction, pulsed electric field extraction etc. This extracted bioactive compounds are now often used for the production of different functional and nutraceutical food products such as**,** gluten-free crackers, ice cream, bread, yogurt, cheese, fruit purees, snack bar etc. However, food by-products can also be used for production of some non-food innovative products such as t-shirts made with the help of sour milk, food containers made from coffee grounds and husks or car parts made from food waste.

Keywords: food waste, bioactive compounds, valorisation of food by-products, utilisation of food by-products

MOGUĆNOSTI ISKORIŠTENJA OSTATAKA OD PROIZVODNJE HMELJA

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pozvano predavanje

Predstavljaju se mogućnosti iskorištenja ostataka iz proizvodnje hmeljnih češera koji se koriste u pivarskoj industriji. Navedeni ostatci uključuju lišće i stabljiku biljke hmelja (otpadni hmelj), čije zbrinjavanje s obzirom na količinu ovih ostataka može predstavljati problem. Prikazano je nekoliko mogućih načina iskorištenja otpadnog hmelja. Najčešća upotreba je njegova prerada u kompost koji se potom može vratiti na polja ili koristiti u druge poljoprivredne svrhe. Također je moguće iz ostataka proizvodnje hmeljnih češera proizvoditi i bioplin anaerobnom digestijom, gdje se predobradom otpada može značajno povećati potencijal proizvodnje. Slijedi mogućnost iskorištenja otpadnog hmelja kao sirovine za izolaciju polifenolnih spojeva, koji imaju dokazanu antioksidacijsku aktivnost i koji se dalje mogu koristiti kao aditivi u prehrambenoj industriji ili u medicinske svrhe. Spaljivanje otpadnog hmelja u svrhu proizvodnje topline još je jedna od mogućnosti njegovog iskorištenja, dok njegovo iskorištenje za dobivanje vlakana koja se mogu iskoristiti u proizvodnji biokompozitnih materijala predstavlja inovativni pristup rješavanju problema zbrinjavanja otpadne biljne biomase.

Ključne riječi: hmelj, kompostiranje, anaerobna digestija, polifenoli, biokompozit

POSSIBILITIES OF UTILIZATION OF HOP PRODUCTION RESIDUES

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invited lecture

Possibilities of the utilization of residues from the production of hop cones used in the brewing industry are presented. These residues include the leaves and stem of the hop plant (waste hops), the disposal of which, given the amount of these residues, can be a problem. Several possible ways of using waste hops are presented. The most common use is its processing into compost, which can then be returned to the fields or used for other agricultural purposes. It is also possible to produce biogas by anaerobic digestion from the residues of hop cone production, where pre-treatment of waste can significantly increase the production potential. The possibility of using waste hops as a raw material for the isolation of polyphenolic compounds, which have proven antioxidant activity and which can be further used as additives in the food industry or for medical purposes, follows. Incineration of waste hops for heat production is another possibility of its utilization, while its utilization to obtain fibers that can be used in the production of biocomposite materials is an innovative approach to solving the problem of waste plant biomass.

Keywords: hops, composting, anaerobic digestion, polyphenols, biocomposite

KONTAMINANTI U PREHRAMBENOM LANCU OD NUSPROIZVODA PREHRAMBENE INDUSTRIJE DO FINALNIH PROIZVODA

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pozvano predavanje

Kontaminanti predstavljaju kemijske tvari koje se u hranu ne dodaju namjerno, ali se mogu nalaziti u njoj kao posljedica proizvodnje, prerade, skladištenja i ostalih faza tijekom rukovanja i pripreme hrane, a mogu biti i posljedica prirodnog te okolišnog onečišćenja. Ove tvari mogu prodrijeti u hranidbeni sustav čovjeka putem nusprodukata prehrambene industrije, ukoliko se oni kao kontaminirane sirovine koriste u daljnjoj proizvodnji hrane, te predstavljati potencijalni izvor onečišćenja. Pritom su izvori i mehanizmi kontaminacije u lancu „od polja do stola" jedinstveni za svaku fazu hranidbenoga sustava. Najznačajniji kontaminanti hrane pripadaju skupini mikotoksina, teških metala, dioksina, polikloriranih bifenila, policikličkih aromatskih ugljikovodika, te uključuju i 3-monokloropropan-1,2-diol, melamin, eruka kiselinu i nitrate. Istraživanja pokazuju da prisutnost ovih tvari u hrani može prouzročiti štetne učinke po ljudsko zdravlje, od blagog gastroenteritisa do fatalnih slučajeva jetrenih, bubrežnih i neuroloških sindroma. Unatoč širokoj pojavnosti u hrani, varijabilnost svojstava i toksičnih učinaka ovih kemijskih spojeva onemogućavaju donošenje jedinstvenih mjera prevencije i mogućnosti dekontaminacije, a zbog njihove općenito visoke perzistentnosti i mogućnosti bioakumulacije, ove tvari predstavljaju značajan rizik za sigurnost namirnica te time i zdravlje potrošača. Kako bi se smanjila razina i učestalost zagađenja, ujedno u cilju uspostave održivog kružnog hranidbenog sustava, nužno je definirati rizik od zagađenja hrane kemijskim tvarima i njime pomno upravljati. Stoga je u cilju proizvodnje zdravstveno ispravne hrane i zaštite zdravlja potrošača neupitan značaj sustavnog nadzora kontaminanata, osim u finalnim proizvodima i u nusproizvodima prehrambene industrije koji se kao sirovine koriste u daljnjoj proizvodnji hrane.

Ključne riječi: kontaminanti, nusproizvodi, prehrambeni lanac, sigurnost hrane, kontrola

FOOD CHAIN CONTAMINANTS FROM BY-PRODUCTS OF THE FOOD INDUSTRY TO FINAL PRODUCTS

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invited lecture

Contaminants are chemicals that are not added to food intentionally, but may be present as a result of production, processing, storage and other stages during food handling and preparation, and may be the result of natural and environmental contamination. These substances can penetrate the human food system through by-products of the food industry, if they are used as contaminated raw materials in further food production, and represent a potential source of pollution. The sources and mechanisms of contamination in the chain "from the field to the table" are unique for each phase of the food system. The most significant food contaminants belong to the group of mycotoxins, heavy metals, dioxins, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, and include 3-monochloropropane-1,2-diol, melamine, erucic acid and nitrates. Studies show that the presence of these substances in food can cause adverse effects on human health, from mild gastroenteritis to fatal cases of liver, kidney and neurological syndromes. Despite their wide occurrence in food, the variability of properties and toxic effects of these chemical compounds make it impossible to adopt unique prevention measures and decontamination options, and due to their generally high persistence and bioaccumulation potential, these substances pose a significant risk for product safety and consumer health. In order to reduce the level and frequency of pollution, at the same time in order to establish a sustainable circular food system, it is necessary to define the risk of food contamination by chemical substances and manage it carefully. Therefore, in order to produce safety food and protect the health of consumers, the importance of systematic control of contaminants is unquestionable, except in final products and in by-products of the food industry that are used as raw materials in further food production.

Keywords: wax, contaminants, by-products, food chain, food safety, control

ORAL PRESENTATIONS / USMENA PRIOPĆENJA

TRANSFORMACIJSKI POTENCIJAL OTPADNE BIOMASE LUKA

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usmeno priopćenje

Luk je jedna od često korištenih namirnica, čija otpadna biomasa nakon proizvodnje i industrijske prerade završava na otpadu, što predstavlja značajno ekološko i ekonomsko opterećenje kako za industriju tako i po okoliš. Sukladno tome, inovativne tehnike obrade i iscrpljivanja otpadne biomase luka dobivaju sve više na važnosti. Otpadna biomasa luka se ističe kao visokovrijedna sirovina za daljnje iskorištenje zbog osebujnog kemijskog sastava koji uključuje visok udio prehrambenih vlakana, minerala, antioksidanasa, organo-sumpornih spojeva i dominantnog flavonola kvercetina. Sukladno tome, posjeduje veliki potencijal za proizvodnju i uporabu funkcionalnih sastojaka u poboljšanju postojećih i/ili razvoju novih prozvoda prehrambene industrije. Uz navedeno, biomasa luka je potencijalna sirovina za proizvodnju biomaterijala, biogoriva i bioenergije.

Ključne riječi: otpadna biomasa luka, kvercetin, prehrambena vlaka, uporaba

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TRANSFORMATION POTENTIAL OF WASTE ONION BIOMASS

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oral presentation

Onion is one of the most consumed foods in the world, whose biomass after production and industrial processing ends up in landfills, what represent a significant environmental and economic burden, both for the industry and the environment. Accordingly, innovative techniques of onion waste biomass transformation and its depletion are gaining on the importance. Waste onion biomass stands out as a high-value raw material for further use due to its distinctive chemical composition including a high amounts of dietary fibers, minerals, antioxidants, organosulfuric compounds, as well as the dominant flavonol quercetin. Therefore, it has a great potential for the production and the use of a functional ingredients for the improvement of existing and/or development of new food industry products. In addition, onion biomass has a great potential as raw material for the production of biomaterials, biofuels and bioenergy.

Keywords: waste onion biomass, quercetin, dietary fibers, reuse

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UTJECAJ DISAHARIDA NA ADSORPCIJU POLIFENOLA SOKA ARONIJE NA CITRUS VLAKNA

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usmeno priopćenje

U današnje vrijeme prehrambena industrija orijentirana je na iskorištavanje otpada pa stoga otpad od citrusa može imati široku primjenu. Otpad od citrusa iznimno je bogat prehrambenim vlaknima (pektin, celuloza, hemiceluloza), te kao takav predstavlja vrijednu sirovinu. Cilj našeg istraživanja bio je primijeniti prehrambena vlakna iz citrusa kao nosače za bioaktivne komponente soka aronije; polifenole. Tijekom adsorpcije, u sustav su dodane saharoza ili trehaloza kako bi se ispitao njihov učinak na vezanje polifenola. Pripremljeni uzorci liofilizirani su kako bi se proizveo suhi prah. Spektrofotometrijskim metodama određene su količine ukupnih polifenola, proantocijanidina i antocijana, te antioksidacijska aktivnost pomoću 4 testa (ABTS, DPPH, FRAP i CUPRAC). Individualni polifenoli identificirani su i kvantificirani pimjenom tekućinske kromatografije visoke djelotvornosti (HPLC). Rezultati su pokazali kako je dodatak disaharida negativno utjecao na adsorpciju polifenola, a antioksidacijska aktivnost pratila je taj trend. Uzorci s trehalozom imali su veću količinu polifenolnih spojeva (osim klorogenske kiseline) u odnosu na uzorke sa saharozom. Neoklorogenska kiselina imala je suprotan trend, te je njena najveća količina određena u uzorku sa saharozom (280,64 mg/100 g). Izmjereni su parametri boje uzoraka te je provedena FTIR-ATR analiza kako bi se dokazalo vezanje polifenola na vlakna. Ovakvi pripravci mogu se koristiti u prehrambenoj industriji za obogaćivanje postojećih proizvoda s vlaknima i antioksidansima ili za razvoj novih proizvoda s dodanom vrijednošću.

Ključne riječi: citrus vlakna, sok aronije, polifenoli, saharoza, trehaloza

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EFFECT OF DISACCHARIDES ON THE ADSORPTION OF CHOKEBERRY JUICE POLYPHENOLS ON CITRUS FIBERS

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oral presentation

Nowadays food industry becomes strongly oriented toward the exploitation of food waste where citrus waste can find its application since it offers a wide range of possibilities. Citrus waste is very rich in dietary fibers such as pectin, cellulose, and hemicellulose which makes it a very valuable raw material. The aim of our research was to apply citrus dietary fibers as carriers for valuable bioactive components from chokeberry juice; polyphenols. During adsorption, sucrose or trehalose were added to the system to examine their effect on the process. The prepared samples were freeze-dried to obtain dry powder. Spectrophotometric methods were used for the evaluation of total polyphenols, proanthocyanidins and anthocyanins, as well as antioxidant activity (ABTS, DPPH, FRAP and CUPRAC assays). Individual polyphenols were identified and quantified using high-performance liquid chromatography (HPLC). The results showed that the addition of disaccharides negatively affected the adsorption of polyphenols, and antioxidant activity followed the same trend. Samples with trehalose had a higher concentration of polyphenolic compounds (except for chlorogenic acid) than those with sucrose. Neochlorogenic acid had the opposite trend and its maximum concentration was determined in a sample with sucrose (280.64 mg/100 g). The color parameters were measured and FTIR-ATR analysis was performed to prove the binding of polyphenols to the fibers. Such samples can be used in the food industry to enrich existing products with fibers and antioxidants or to develop new value-added products.

Keywords: citrus fibers, chokeberry juice, polyphenols, sucrose, trehalose

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MOGUĆNOSTI ISKORIŠTENJA NUSPROIZVODA INDUSTRIJA SLADA I PIVA

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usmeno priopćenje

Industrija piva i s njom povezana industrija slada, kao i primarna poljoprivredna proizvodnja žitarica i hmelja koji se koriste kao sirovine, imaju značajan (negativan) utjecaj na okoliš, kako zbog velike potrošnje energije i vode, tako i zbog velike količine proizvodnih ostataka nastalih tijekom proizvodnje, za čiju ponovnu uporabu ili zbrinjavanje ne postoje dovoljno održive strategije. Međutim, provode se intenzivna istraživanja i predložena su mnoga rješenja za otklanjanje ovih problema. Predložene mogućnosti upotrebe sladnih klica i korjenčića su kao sirovina za proizvodnju stočne hrane, dodatak u proizvodnji funkcionalne hrane, kao supstrat za proizvodnju mliječne kiseline i kao medij za rast i čuvanje kultura mliječno kiselih bakterija. Pivski trop može se koristiti za proizvodnju bioplina, kao stočna hrana, kao dodatak u prehrani ljudi i u biotehnološkoj proizvodnji te kao biosorbens za uklanjanje onečišćujućih tvari iz vode. Topli i hladni (proteinski) talog mogu se koristiti kao alternativa izvorima biljnih proteina ili kao dodatak hranjivim medijima u raznim industrijskim bioprocesima. Otpadni hmelj može se upotrijebiti kao izvor eteričnih ulja bogatih terpenima, dok se otpadni kvasac koristi kao dodatak hrani, kao komponenta za proizvodnju funkcionalne hrane ili kao dodatak hranjivim podlogama za uzgoj mikroorganizama. Višak CO_2 mogao bi se koristiti za proizvodnju biogoriva ili za proizvodnju jantarne kiseline pomoću nekih nefotosintetskih mikroorganizama.

Ključne riječi: nusproizvodi, slad, pivo, otpadni hmelj, otpadni kvasac, CO_2

POSSIBILITIES OF USING BY-PRODUCTS OF THE MALT AND BEER INDUSTRY

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oral presentation

The beer industry and the associated malt industry, as well as the primary agricultural production of grains and hops used as raw materials, have a significant (negative) impact on the environment, both because of the high energy and water consumption and because of the large quantities of production residues generated during manufacturing, for whose reuse or disposal there are not sufficiently sustainable strategies. However, intensive research is being carried out and many solutions have been proposed to address these issues. The proposed uses of malt sprouts and roots are as a raw material for the production of animal feed, for the production of functional foods, as a substrate for the production of lactic acid, and as a medium for the growth and storage of lactic acid cultures. Among other uses, brewer's grains are used for biogas production, as animal feed, for human consumption and in biotechnological production, and as a biosorbent to remove pollutants from water. Hot and cold (protein) turb can be used as an alternative to plant protein sources or as a supplement to nutrient media in various industrial bioprocesses. Waste hops can be used as a source of essential oils rich in terpenes, while waste yeast is used as a feed additive, as a component for the production of functional foods, or as a supplement to nutrient media for the cultivation of microorganisms. Excess carbon dioxide could be used for the production of biofuels or for the production of succinic acid by some non-photosynthetic microorganisms.

Keywords: by-products, malt, beer, waste hops, waste yeast, CO_2, wastewater

SENZORSKA SVOJSTVA KREM-PROIZVODA S KAKAOVOM LJUSKOM

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usmeno priopćenje

Krem-proizvode karakterizira visok sadržaj šećera i masti, visoka senzorska prihvatljivost među svim generacijama, ali i niska nutritivna vrijednost. S ciljem povećanja nutritivne vrijednosti/smanjenja kalorijske vrijednosti, krem-proizvodi se obogaćuju različitim dodacima i/ili zamjenama za pojedine sastojke. Kakaova ljuska je nusproizvod prehrambene industrije koji se zbog povoljnog nutritivnog sastava (vlakna, polifenoli) sve više koristi u proizvodnji funkcionalnih proizvoda. U razvoju novog proizvoda, senzorska karakterizacija jedan je od ključnih pokazatelja kvalitete i mogućeg uspjeha na tržištu. U ovom istraživanju ispitana su senzorska svojstva krem-proizvoda s dodatkom različitih udjela kakaove ljuske u kombinaciji sa zamjenama za šećer (ksilitol i stevia) te različitim mastima i emulgatorima uz kontrolni uzorak (krem-proizvod bez kakaove ljuske). Senzorska svojstva (oblik, boja, površina, konzistencija, žvakanje, miris i okus) krem-proizvoda ocjenio je panel od 5 ocjenjivača metodom bodovanja. Iako su svi obogaćeni krem-proizvodi ocjenjeni nižim ocjenama od kontrolnog, uzorci sa većim udjelom kakaove ljuske bolje su ocjenjeni od proizvoda sa najmanjim udjelom dodane kakaove ljuske koji je imao najnižu sumu ponderiranih bodova. Ukupno gledajući, svi obogaćeni krem-proizvodi su prihvatljivi jer su prosječne ocjene pojedinih senzorskih svojstava kao i sve sume ponderiranih bodova više od minimalnih prihvatljivih vrijednosti. Daljnja ispitivanja potrebna su kako bi se ispitale nove kombinacije kakaove ljuske i drugih dodatka/zamjena kako bi se poboljšala senzorska svojstva krem-proizvoda sa kakaovom ljuskom.

Ključne riječi: krem-proizvod, kakaova ljuska, senzorska svojstva

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SENSORY ATTRIBUTES OF SWEET SPREADS WITH COCOA SHELL

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Sweet spreads are characterized by high sugar and fat content, high sensory acceptability among all generations, but also low nutritional value. In order to increase the nutritional value/reduce the caloric value, sweet spreads are enriched with various additives and/or replacements for specific ingredients. Cocoa shell is a by-product of the food industry which, due to its favorable nutritional composition (fiber, polyphenols), is increasingly used in the production of functional products. In the development of a new product, sensory characterization is one of the key indicators of quality and possible success in the market. In this study, the sensory properties of sweet spreads with the addition of different share of cocoa shell in combination with sugar substitutes (xylitol and stevia) and various fats and emulsifiers against a control sample (sweet spread without cocoa shell) were examined. Sensory attributes (form, color, surface, consistency, chewing, odor and taste) of the sweet spreads were evaluated by a panel of 5 assessors using the scoring method. Although all enriched sweet spreads were rated lower than the control, samples with a higher cocoa shell content were rated better than product with the lowest added cocoa shell content, which had the lowest total weighted score. Overall, all enriched sweet spreads are acceptable because the average points of individual sensory properties as well as all total weighted scores are more than the minimum acceptable values. Future researches are needed to evaluate new combinations of cocoa shell and other additives/replacements to improve the sensory attributes of cocoa shell sweet spreads.

Keywords: sweet spread, cocoa shell, sensory attributes

This work has been supported in part by Croatian Science Foundation under the project UIP 2017-05-8709.

PROFILIRANJE INOVACIJA ZA PRELAZAK HRVATSKE INDUSTRIJE TEMELJENE NA BIOMASI NA KRUŽNU I ODRŽIVU BIOEKONOMIJU

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usmeno priopćenje

Prelazak na kružnu i održivu (bio)ekonomiju omogućava odvajanje gospodarskog rasta od resursa i emisija stakleničkih plinova, temeljnih postavki Europskog zelenog plana. Regije s teritorijalnim kapitalom temeljenim na biomasi – od raspoloživosti biomase preko prerađivačke industrije do infrastrukture i nosioca znanja za istraživanje, razvoj i inovacije – imaju komparativnu prednost za održivi rast povećanje iskoristivosti već angažirane i raspoložive održivo dobavljene biomase. Inovacije primjerene industriji i vlasnicima biomase su neophodne za održivo kruženje sekundarne biomase.
Rad prikazuje glavne rezultate istraživanja potreba za inovacijama duž cijelog vrijednosnog lanca za prelazak hrvatske industrije temeljene na biomasi na kružnu i održivu bioekonomiju. Rezultati su dio šireg istraživanja usmjerenog na 11 zemalja središnje i istočne Europe, organizirane u BIOEAST Inicijativu, temeljenog na Strateškoj agendi za istraživanje i razvoj Circular Bioeconomy Joint Undertaking (CBE JU), partnerstvo na razini Europske unije koje usmjerava inovacije za ubrzanje prelaska industrije temeljene na biomasi na kružnu i održivu bioekonomiju.

Ključne riječi: kružna i održiva bioekonomija, inovacije, biomasa, biotehnologija

PROFILING INNOVATIONS FOR TRANSITION OF THE CROATIAN BIO-BASED INDUSTRY TO A CIRCULAR AND SUSTAINABLE BIOECONOMY

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Transition to a circular and sustainable (bio)economy allows economic growth decoupled from resource use and greenhouse gas emissions, the cornerstones of the European Green Deal. Regions with biomass based territorial capital – from biomass availability over biomass processing and research, development & innovation infrastructure and knowledge carriers – gain a competitive advantage for sustainable growth by increasing material efficiency of already engaged and sustainably sourced biomass. Tailored innovations to combine biomass owners and industries are essential to circulate sustainably secondary biomass.
The work highlights innovations needed along the whole biomass value chain for transition of the Croatian bio-based industry to a circular and sustainable bioeconomy. Results represent a national section of a wider research that covers 11 Central and Eastern European countries, organised in a BIOEAST Initiative. The research stems from the Strategic and Research Innovation Agenda of Circular Bioeconomy Joint Undertaking (CBE JU), an EU partnership that streamlines innovations to accelerate transition to a bio-based industry within circular and sustainable bioeconomy.

Keywords: ciruclar and sustainable bioeconomy, innovations, biomass, biotechnology

FENOLNI PROFIL HLADNO PREŠANOG ULJA SJEMENKI GROŽĐA SORTE TERAN (*Vitis vinifera* L.): UTJECAJ PREDFERMENTATIVNOG HLAĐENJA I ZAGRIJAVANJA MASULJA, TE PRODUŽENIH MACERACIJA

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Cilj ovog istraživanja bio je odrediti ukupni sadržaj i koncentracije pojedinih fenola u hladno prešanom ulju sjemenki grožđa *cv*. Teran (*Vitis vinifera* L.) dobivenom prešanjem vijčanom prešom. Sjemenke su dobivene iz šest različitih vinifikacijskih tretmana koji su bili podvrgnuti: 48-satnom predfermentativnom hlađenju masulja (8 °C), na što se nastavila maceracija od 13 dana (C15) i 28 dana (C30), te *saignée* tehnologiji nakon čega je slijedila maceracija od 13 dana (CS15). Dva vinifikacijska tretmana bila su podvrgnuta 48-satnom predfermentacijskom zagrijavanju (50 °C), nakon čega je slijedila maceracija od 13 dana (H15) i 28 dana (H30). Također, ovaj pokus je uključivao i kontrolni tretman (K7), s maceracijom u trajanju od 7 dana. Nakon završetka maceracije, fermentirani masulj je prešan, a sjemenke su sakupljene i sušene na 38 °C u komori za sušenje grožđa dok se vlaga u sjemenci nije spustila na 5-8 %. Sjemenke su zatim vakumirane i skladištene do prešanja. Dobiveno ulje je centrifugirano i čuvano na -18 °C prije analiza. Ukupni sadržaj fenola (TPC) analiziran je Folin–Ciocalteau kolorimetrijskom metodom i UV/VIS spektrofotometrom. Pojedinačni fenolni spojevi analizirani su tekućinskom kromatografijom visoke učinkovitosti (HPLC). Rezultati su pokazali da je ukupni sadržaj fenola značajno veći (mgCAEkg^{-1} ulja) u ulju iz svih tretmana, osim C15, u usporedbi s uljem iz kontrolnog tretmana (K7). Što se tiče pojedinačnih fenola, utvrđeno je da su resveratrol, tirozol, kvercetin i kempferol najviši u ulju iz tretmana zagrijavanjem (H30). Dobiveni rezultati upućuju na zamjetan utjecaj predfermentacijskih tretmana i produljenih maceracija na fenole u hladno prešanom ulju sjemenki grožđa.

Ključne riječi: sorta Teran, hladno prešano ulje sjemenki grožđa, ukupni sadržaj fenola, HPLC fenoli, predfermentativni tretmani masulja

PHENOLIC PROFILE OF COLD-PRESSED GRAPE SEED OIL FROM TERAN RED GRAPE VARIETY (*Vitis vinifera* L.): IMPACT OF PRE-FERMENTATIVE MASH COOLING, HEATING, AND PROLONGED MACERATIONS

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This study aimed to determine total phenolic content and concentrations of individual phenolics in cold-pressed grape seed oil obtained by screw pressing of grape seeds of *cv*. Teran *(Vitis vinifera* L.). Those seeds derived from six different vinification treatments that were submitted: to 48-h pre-fermentative mash cooling (8 °C) followed by maceration of 13 days (C15), 28 days (C30) and *saignée* technique followed by maceration of 13 days (CS15), and to 48-h pre-fermentative heating (50 °C) followed by maceration of 13 days (H15) and 28 days (H30). Also, this experiment included a control tank (K7), with a 7-day maceration. After macerations ended, fermented mashes were pressed, and seeds were collected and dried at 38 °C in dehydrating chamber until 5-8 % of moisture content in seeds was reached. Then they were vacuum-packed and stored until screw pressing. The obtained oil was centrifuged and stored at -18 °C prior to analysis. Total phenolic content (TPC) was analyzed by Folin–Ciocalteau colorimetric method and UV/VIS spectrophotometer. Individual phenolic compounds were analyzed by high-performance liquid chromatography (HPLC). Results showed that total phenolic content (mgCAEkg^{-1} oil) in oil from all treatments, except C15, was significantly higher compared to oil from the control treatment (K7). Respectively, TPC increased with longer duration of maceration. Regarding individual phenolics, it was found that resveratrol, tyrosol, quercetin and kaempferol were significantly the highest in oil from pre-fermentative heating treatment (H30). Obtained results suggested a noticeable impact of pre-fermentative treatments and prolonged macerations on phenolics in cold-pressed grape seed oil.

Keywords: Teran red grape variety, cold pressed grape seed oil, total phenolic content, HPLC phenolics, pre-fermentative mash treatments

VINSKI TALOG – KARAKTERIZACIJA I POTENCIJALNA PRIMJENA

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usmeno priopćenje

Posljednih godina izniman interes znanstvene zajednice i dionika gospodarskog sektora usmjeren je na potencijalno iskorištavanje nusproizvoda prehrambene industrije. Ti nusproizvodi su često vrijedan izvor brojnih sastojaka s pozitivnim učinkom na ljudsko zdravlje. Nusproizvodi vinarstva kao što su komina, peteljkovina i talog čine oko 30 % ukupne količine prerađenog grožđa. Iako se vinarstvo smatra ekološki prihvatljivim procesom, tijekom proizvodnje vina nastaje 1,3 – 1,5 kg nusproizvoda po litri proizvedenog vina, od čega oko 75 % otpada na otpadnu vodu. Prema novijim istraživanjima samo u Europi na godišnjoj razni nastaje 14,5 milijuna tona nusproizvoda tijekom proizvodnje vina. Većina ovih nusproizvoda uglavnom završi na odlagalištima bez ikakvih daljnjih tretmana. Budući da se vinski talog smatra značajnim onečišćivačem tla, njegovo zbrinjavanje predstavlja izniman trošak za vinarije te je u posljednje vrijeme u fokusu brojnih istraživanja njegova optimalna upotreba i valorizacija. Vinski talog čini 2 – 6 % ukupne količine nusproizvoda u proizvodnji vina, a nastaje kao ostatak na dnu vinskih posuda tijekom niza operacija u tehnološkom procesu proizvodnje vina. Sastoji se uglavnom od mikroorganizama (većinom odumrle stanice kvasaca), vinske kiseline, anorganskih tvari i fenolnih spojeva. Dosadašnja praksa iskorištavanja vinskog taloga je u vidu dodataka stočnoj hrani te ekstrakcije etanola i vinske kiseline Ipak, recentna istraživanja ukazuju kako vinski talog, uz odgovarajuću obradu, može biti koristan izvor brojnih visokovrijednih bioaktivnih sastojaka poput fenolnih spojeva i polisaharida stanične stijenke kvasaca (manoproteini i β-glukani). Upravo ovi spojevi imaju potencijalnu primjenu u vinarskoj, prehrambenoj, biotehnološkoj, kozmetičkoj i farmaceutskoj industriji. Pored toga, novija istraživanja ukazuju na mogućnost primjene vinskog taloga u proizvodnji bioplina kao i polimera na bioosnovi.

Ključne riječi: nusproizvodi, vinski talog, bioaktivni sastojci, valorizacija

WINE LEES – CHARACTERISATION AND POTENTIAL APPLICATION

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In recent years, the exceptional interest of the scientific community and economic sector has been focused on potentially exploiting food industry by-products.These by-products are often a valuable source of numerous ingredients with a positive impact on human health. Winemaking by-products such as pomace, stalk and lees account for around 30 % of the total amount of processed grapes. Although winemaking is considered an environmentally friendly process, 1.3-1.5 kg of by-products per litre of wine produced are produced during wine production, of which around 75 % are wastewater. According to recent researche, only in Europe 14.5 million tonnes of by-products are produced annuallyduring winemaking. Most of these by-products generally end up in landfills without any further treatment. Since wine lees are considered a significant pollutant of the soil, its disposal represents an exceptional cost for wineries and has recently been the focus of numerous studies on its optimal use and valorization. Wine lees accounts for 2 – 6 % of the total amount of by-products in wine production and generates at the bottom of the wine tank during numerous operations in technological process of wine production. It consists mainly of microorganisms (mostly dead yeast cells), tartaric acid, inorganic substances and valuable phenolic ingredients. The current practice of the exploitation of wine leess is in the form of feed additives, ethanol and tartaric acid extraction. However, recent studies suggests that by-products of the wine industry such as wine lees can, with proper treatment, be a useful source of numerous high-value bioactive ingredients such as phenolic compounds and polysaccharides of yeast cell wall (manoproteins and *β*-glucans). These compounds have potential use in the winemaking, food industry, biotechnology, cosmetic and pharmaceutical industries. Likewise, recent research points to the potential use of wine lees in the production of biogas as well as bio-based polymers.

Keywords: by-products, wine lees, bioactive compounds, valorisation

BIOVALORIZACIJA BUČINE POGAČE

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Kružno biogospodarstvo temelji se na kaskadnom, učinkovitom i održivom iskorištavanju lignocelulozne biomase porijeklom iz prehrambene industrije, šumarstva i poljoprivrede, u svrhu proizvodnje hrane, bioproizvoda i energije. Jedan od načina ostvarivanja ciljeva biogospodarstva je razvoj i primjena lignoceluloznih biorafinerija.

U ovom radu biti će prikazana mogućnost biovalorizacije bučine pogače s ciljem proizvodnje enzima lipaza uz istovremenu proizvodnju mikrobno izmjenjene bučine pogače za moguću primjenu u proizvodnji stočne hrane i/ili biognojiva.

Bučina pogača je korištena kao čvrsti nosač i izvor potrebnih hranjivih tvari za uzgoj termofilne gljive *Thermomyces lanuginosus* u šaržnim uvjetima fermentacije na čvrstim nosačima (eng. SSF), u bioreaktoru s pliticama s kontinuiranom dobavom vode (Euklid d.o.o., Vinkovci), tijekom 7 dana, prema sljedećim početnim procesnim uvjetima: m(bučine pogače) = 1 kg, w(vode) = 60 %, w(inokuluma) = 35 %, T = 45 °C. Aktivnost lipaze je mjerena svaki dan. Najveća volumna aktivnost lipaze ($V.A.$ = 50 U mL^{-1}) je postignuta nakon trećeg dana fermentacije. Enzim je dalje pročišćen primjenom vodenih dvofaznih sustava (PEG 6000:$(NH_4)_2SO_4$ = 5:19, w/w), precipitacijom s acetonom (75%, v/v) i stabilizacijom eutektičkim otapalom (kolin klorid:glicelor = 1:2), pri čemu je postignuta aktivnost lipaze od 5000 U mL^{-1}.

Dodatno, napravljena je analiza kemijskog sastava biološki obrađene bučine pogače nakon trećeg dana fermentacije pri čemu je dokazano da razvijeni proces utječe na povećanje udjela ergosterola (provitamin D2), proteina, amonijskog dušika, topivog dušika, topivog ugljika, kalcija i polifenola te na smanjenje udjela masti i bruto energije. Koncentracija nitrata i nitrita bila je ispod granice detekcije te nije utvrđena prisutnost mikotoksina.

Ključne riječi: biogospodarstvo, fermentacija na čvrstim nosačima, kaskadno iskorištavanje biomase, lipaza*, Thermomyces lanuginosus*

BIOVALORIZATION OF PUMPKIN POMACE

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oral presentation

The circular bioeconomy is based on the cascading, efficient, and sustainable use of lignocellulosic biomass from the food industry, forestry, and agriculture to produce food, biobased products, and bioenergy. One of the methods to achieve the bioeconomy goals is the development and application of lignocellulosic biorefineries. In this work, the possibility of biovalorizing pumpkin pomace to produce the enzyme lipase while producing microbially modified biomass for potential use in feed and/or biofertilizer production is investigated.

Pumpkin pomace was used as a solid carrier and source of necessary nutrients for 7-day solid-state fermentation of the thermophilic fungus *Thermomyces lanuginosus* in a tray bioreactor with continuous water supply (Euklid d.o.o., Vinkovci) under the following initial process conditions: *m*(pumpkin marc) = 1 kg, *w*(water) = 60%, *w*(inoculum) = 35%, *T* = 45 °C. Lipase activity was measured daily. The highest activity was reached after the third day of fermentation (*V.A.* = 50 U mL^{-1}). The enzyme was further purified with aqueous two-phase systems (PEG 6000:$(NH_4)_2SO_4$ = 5:19, *w*/*w*), precipitated with acetone (75%, *v*/*v*), and stabilized with a deep eutectic solvent (choline chloride: glycerol = 1:2), resulting in a lipase activity of 5000 U mL^{-1}. In addition, a chemical composition analysis of the biologically treated pumpkin pomace was performed after the third day of SSF. It was demonstrated that the SSF process resulted in an increase in ergosterol (provitamin D2), protein, ammoniacal nitrogen, soluble nitrogen, soluble carbon, calcium, and polyphenols, and that fat content and gross energy decreased. Nitrate and nitrite concentrations were below the detection limit, and the presence of mycotoxins was not detected.

Keywords: bioeconomy, solid-state fermentation, cascading biomass utilization, lipase, *Thermomyces lanuginosus*

PRIMJENA ZELENIH OTAPALA U ISKORIŠTENJU NUSPROIZVODA I OTPADA IZ PREHRAMBENE INDUSTRIJE

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usmeno priopćenje

Gotovo svaka grana prehrambena industrija proizvodi značajne količine nusproizvoda i otpada koji nastaju preradom različitih biljnih sirovina različitim proizvodnim procesima. Biljni nusproizvodi, kao i biljnih otpad,većinom i dalje predstavljaju značajan izvor nutritivno vrijednih ili biokativnih komponenti (proteina, ugljikohidrata, lipida, vitamina, minerala, pigmenata, polifenola itd.). Primjenom odgovarajućih tehnologija iz ovakvih izvora ove komponenete se mogu izolirati ili preraditi u novi vrijedan proizvod koji može biti plasiran na tržište. Osim konverzije u kvalitativno i cjenovno vrijedniji proizvod, iskorištenjem biljnih nusproizvoda, a posebno biljnog otpada, smanjuje se negativan utjecaj na životnu sredinu kao i financijsko ulaganje proizvođača za pravilno odlaganje otpadnih tokova.
Za izoliranje bioaktivnih komponenti i proizvodnju biljnih ekstrakata iz ovakvih biljnih izvora, danas se sve više primjenjuju zelene ekstrakcijske tehnologije. Primjena zelenih inovativnih postupaka ekstrakcije u skladu je sa smjernicama „zelene kemije“ i smjernicama održivog razvoja. U isto vrijeme plasman biljnih ekstrakta proizvedenih na ovaj način samom proizvođaču daje značajnu prednost na tržištu i povoljno pozicioniranje. Na tržištu se danas uočava povećano interesiranje za implementacijom nekoliko zelenih ekstrakcijskih tehnologija: ekstrakcije fluidima pod tlakom i ekstrakcije primjenom ultrazvučnih valova. Ove tehnologije u svom radu koriste zelena otapala: superkritični ugljeikov dioksid, subkritičnu vodu, etanol, kao i različite sustave eutektičkih ili prirodnih eutektičkih otapala. I tehnologije i zelena otapala plasirani su na tržište kao alternativa postojećim konvencionalnim tehnologijama i toksičnim otapalima, a njihova osnovna prednost su: veća efikasnost procesa, proizvodnja zdravstveno sigurnog proizvoda i odsustvo negativnog utjecaja na životnu sredinu.

Ključne riječi: biljni opad, ekstrakcija, superkritični fluid, subkritična voda, eutektička otapala

APPLICATION OF GREEN SOLVENTS IN THE VALORIZATION OF FOOD INDUSTRY BY-PRODUCTS AND WASTES

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Almost every branch of food industry generates significant amounts of by-products and waste, as a result of raw materials processing using different production treatments. Plant by-products, as well as plant waste, in the most cases still represent a significant source of nutritionally valuable or bioactive compounds (proteins, carbohydrates, lipids, vitamins, minerals, pigments, polyphenols, etc.). By applying adequate technology from these sources nutritive or bioactive compounds can be isolated or processed into new valuable products that can be placed on the market. Apart from the conversion into a qualitatively and more competitive by price product, the usage of by-products and plant waste, reduces the negative impact on the environment. Besides, the financial investment needed for the proper disposal of such materials is reduced.

Nowadays for extract production and isolation of bioactive compounds from plant by-products and wastes green extraction technologies are being increasingly applied. Their application is in accordance with the guidelines of "green chemistry" and the guidelines of sustainable development. At the same time, the placement of plant extracts produced in such manner gives the manufacturer a significant advantage on the market and a favourable positioning. Today the increased interest for implementation of following green extraction technologies is noticed: extraction by pressurized fluids, ultrasonic extraction and extraction by eutectic solvents. Green solvents applied in these technologies are: supercritical carbon dioxide, subcritical water, ethanol as well as various systems of eutectic or natural eutectic solvents. Green extraction technologies and green solvents are developed as an alternative to the existing conventional technologies, and their main advantages are: higher process efficiency, production of a health-safe product and the absence of negative environmental impact.

Keywords: plant waste, extraction, supercritical fluid, subcritical water, eutectic solvents

POSTER PRESENTATIONS /
POSTERSKA PRIOPĆENJA

PRIMJENA SUŠENJA RASPRŠIVANJEM U INKAPSULACIJI HESPERIDINA DOBIVENOG IZ KORE CITRUSA

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Kora citrusa je bogata hesperidinom, flavonoidom koji posjeduje mnoge biološke aktivnosti. Novija znanstvena literatura govori o iznimno svestranoj primjeni hesperidina, koja se ogleda u njegovim antioksidativnim, protuupalnim, kardio-protektivnim i antidijabetičkim svojstvima. Međutim, hesperidin je kemijski nestabilan spoj kojega je prije primjene potrebno inkapsulirati kako bi se zaštitila njegova bioaktivnost od vanjskih utjecaja. Sušenje raspršivanjem je tehnika inkapsulacije koja omogućuje vrlo brzo isparavanje vode, a istovremeno relativno nisku temperaturu unutar čestica. U ovom istraživanju, ekstrakti kore citrusa zajedno s nosačima (arapska guma i maltodekstrin) sušeni su na uređaju za sušenje raspršivanjem pri temperaturi od 120 °C i brzini protoka pojne smjese od 4 mL/min. Ekstrakti kore citrusa dobiveni su pomoću ekstrakcije potpomognute ultrazvukom sa 70%-tnim etanolom kao otapalom. Sadržaj hesperidina određen je tekućinskom kromatografijom. Sadržaj hesperidina u mikrokapsulama iznosio je 461,03 mg/g kod mikrokapsula inkapsuliranim maltodekstrinom i 433,76 mg/g za mikrokapsule inkapsulirane s arapskom gumom. Međutim, veći inkapsulacijski kapacitet (razlika između hesperidina na površini mikrokapsula i ukupnog sadržaja hesperidina) postignuta je kada je kao sredstvo za inkapsuliranje korišten maltodekstrin. U konačnici kora citrusa pokazala se kao moguća alternativa komercijalnim izvorima hesperidina, dok se sušenje raspršivanjem pokazalo kao pouzdan i učinkovit alat za njegovo inkapsuliranje.

Ključne riječi: kore citrusa, hesperidin, sušenje raspršivanjem, inkapsulacija

Ovaj rad je sufinancirala Hrvatska zaklada za znanost projektom „Primjena inovativnih tehnika ekstrakcije bioaktivnih komponenti iz nusproizvoda biljnoga podrijetla“ (UIP-2017-05-9909).

APPLICATIONS OF SPRAY-DRYING IN MICROENCAPSULATION OF HESPERIDIN DELIVERED FROM CITRUS PEEL

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The citrus peel contains hesperidin, a flavonoid with a wide range of biological activities. Recent scientific literature discusses the extraordinary versatility of hesperidin, which is reflected in its antioxidant, anti-inflammatory, cardio-protective and antidiabetic properties. However, hesperidin is quite unstable and therefore should be encapsulated to protect its bioactivity from the effects of environmental conditions. Among the other popular microencapsulation techniques, spray drying allows rapid evaporation of water and maintains a relatively low temperature within the particles. In this study, citrus peel extracts were spray-dried using gum Arabic and maltodextrin as encapsulating agents at the temperature of 120 °C and a flow rate of 4 mL/min. Citrus peel extracts were produced by ultrasonic-assisted extraction with 70% ethanol as a solvent, while the determination of hesperidin was performed using high-performance liquid chromatography. The hesperidin retention in the microcapsules was 461.03 and 433.76 mg/g for microcapsules encapsulated with maltodextrin and gum Arabic, respectively. However, higher encapsulation efficiency (difference between surface and total hesperidin content) was achieved when maltodextrin was used as an encapsulating agent. Citrus peel showed as a possible alternative to commercial hesperidin sources, while spray drying showed as a reliable and effective tool for its encapsulation.

Keywords: citrus peel, hesperidin, spray drying, encapsulation

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DODATAK VLAKNA JABUKE U KUPINA/PEKTIN HIDROGELOVE UTJECAO JE NA INHIBICIJU α-GLUKOZIDAZE

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Nusproizvodi prerade jabuka smatraju se potencijalnim dodatcima hrani jer su okarakterizirani kao bogat izvor polifenola i vlakana. Visoke količine polifenola također se nalaze u soku od kupina i drugim tradicionalnim proizvodima od kupina. Poznato je da ovi spojevi inhibiraju α-glukozidazu i time kontroliraju razgradnju škroba, smanjuju hiperglikemiju i reguliraju razinu glukoze u krvi. Budući da su nestabilni, postoji potreba za razvojem novih formulacija koje bi zaštitile polifenole i time poboljšale njihovu funkcionalnost. U ovom smo istraživanju pripremili hidrogelove na bazi soka kupine i dvije vrste pektina (nisko-esterificiranog i visoko-esterificiranog) obogaćene vlaknima jabuke kako bismo ispitali učinak dodavanja vlakana jabuke na inhibiciju α-glukozidaze. Dobivene su IC_{50} vrijednosti (izražene kao µg ekvivalenata galne kiseline po mL reakcijske otopine) i rezultati su pokazali da dodavanje vlakana jabuke u hidrogelove kupine utječe na sposobnost inhibicije ovog enzima. Uzorci s dodatkom vlakna jabuke imali su veće IC_{50} vrijednosti (6,07 µg GAE/mL za nisko-esterificirani pektin i 6,55 µg GAE/mL za visoko-esterificirani pektin) od onih bez dodatka vlakana jabuke (1,98 µg GAE/mL za nisko-esterificirani pektin i 2,41 µg GAE/mL za visoko-esterificirani pektin). Određeni su i pojedinačni polifenoli pripremljenih uzoraka. HPLC analiza pokazala je da su uzorci obogaćeni vlaknima jabuke imali promijenjen sastav polifenola zbog prisutnosti polifenola jabuke. U tim je uzorcima uočeno smanjenje koncentracije antocijana. Provedeno je i skladištenje uzoraka tijekom 8 mjeseci. Rezultati su pokazali da se pripremljeni hidrogelovi mogu koristiti kao poluproizvodi za razvoj novih prehrambenih proizvoda.

Ključne riječi: vlakno jabuke, kupina, hidrogelovi, polifenoli, α-glukozidaza

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ADDITION OF APPLE FIBER TO BLACKBERRY/PECTIN HYDROGELS AFFECTED INHIBITION OF α-GLUCOSIDASE

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poster presentation

By-products of apple processing are considered potential food ingredients since they were characterized as a rich source of polyphenols and fibers. High amounts of polyphenols are also found in blackberry juice and other traditional blackberry products. It is known that these compounds inhibit α-glucosidase and hence control of starch digestion, reduce hyperglycemia and regulate blood glucose levels. Since they are unstable, there is a need to develop novel formulations that would protect polyphenols and thus improve their functionality. In this study, we prepared hydrogels based on blackberry juice and two types of pectin (low-methoxylated and high-methoxylated) fortified with apple fiber to examine the effect of apple fiber addition on inhibition of α-glucosidase. IC_{50} values (expressed as μg of gallic acid equivalents per mL of reaction solution) were obtained and the results showed that the addition of apple fiber to blackberry hydrogels affected the inhibition of this enzyme. Samples with apple fiber addition had higher IC_{50} values (6.07 μg GAE/mL for low-methoxylated pectin and 6.55 μg GAE/mL for high-methoxylated pectin) than those without apple fiber (1.98 μg GAE/mL for low-methoxylated pectin and 2.41 μg GAE/mL for high-methoxylated pectin). Individual polyphenols of the prepared samples were determined as well. HPLC analysis showed that samples fortified with apple fiber had altered polyphenol composition due to the presence of apple polyphenols. In these samples, a decrease in anthocyanins concentrations was observed. A storage study over 8 months period was conducted as well. Results showed that prepared hydrogels can be used as semi-products for the development of novel food products.

Keywords: apple fiber, blackberry, hydrogels, polyphenols, α-glucosidase

This work was supported by the Croatian Science Foundation under project (IP-2019-04-5749) „Design, fabrication and testing of biopolymer gels as delivery systems for bioactive and volatile compounds in innovative functional foods (bioACTIVEgels)", Young Researchers' Career Development Project – Training of New Doctoral Students (DOK-2020-01-4205).

POLYPHENOLS FROM *Prunus spinosa* L. FLOWER EXTRACT CAN IMPACT ON INSULIN LEVEL IN HYPERGLYCEMIC C57BL/6 MICE

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The use of plant extracts in treatment of hyperglycemia is well known in tradicional medicine. In this research we questioned if polyphenols from *Prunus spinosa* L. (PSE) extract can have impact on serum insulin levels after 10 days intake of 25 mg kg^{-1} bm of total polyphenols in hyperglycemic C57BL/6 mice. Hyperglycemia was induced with 150 mg kg^{-1} bm of alloxan. Total of 4 groups of mice: (1) as control (C), (2) as *Prunus spinosa* L. flower extract (PSE), (3) as alloxan group (AL) and (4) as Alloxan group treated with PSE (AL+PSE) were subjected to research.
The PSE intake resulted in higher serum insulin levels, but not significantly, in *Prunus spinosa* L. flower extract group compared to control group on day 1 of experiment. When the *Prunus spinosa* L. flower extract was administrated to the hyperglycemic mice (AL+PSE) there was a significant increase of insulin levels on day 10 of experiment (P=0,0183) compared to alloxan (AL) group. This means that 10 consecutive daily doses of PSE consumption had positive impact on insulin secretion. These findings may be used in designing a nutraceutical polyphenol mixture as a supportive therapy in hyperglycemia managment. In conclusion this research shows that 10 days intake of *Prunus spinosa* L. flower extract can have protective effect on pancreatic beta cells and therefore enhance serum insulin level.

Keywords: hyperglycemia, insulin, mice, polyphenols, *Prunus spinosa* L.

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BIBLIOMETRIJSKA ANALIZA ZNANSTVENIH ISTRAŽIVANJA NUSPROIZVODA PREHRAMBENE INDUSTRIJE OD 1976. DO 2021. GODINE

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Zbog sve veće emisije stakleničkih plinova, zagrijavanja Zemlje i sve većih problema sa zagađenosti okoliša, na globalnoj razini sve su više u fokusu održiva proizvodnja i smanjenje ljudskog utjecaja na okoliš. Europska unija danas teži "nultom utjecaju" na okoliš, što se posebno ističe u Strategiji "European Green Deal". Pred industriju se postavlja zahtjev uvođenja održivih tehnologija, proizvodnje održivih proizvoda i svođenje emisija u okoliš na najmanju moguću mjeru. S novim trendovima i strateškim ciljevima, u novije vrijeme u prehrambenoj industriji nusproizvodi se više ne smatraju otpadom, nego se nastoje iskoristiti kao vrijedne sirovine. U skladu s tim, i znanstvena istraživanja o korištenju nusproizvoda prehrambene industrije u stalnom su porastu.

Cilj ovog istraživanja bio je utvrditi žarišta i smjerove znanstvenih istraživanja koji se odnose na nusproizvode prehrambene industrije. Kombinacijom deskriptivne bibliometrije i vizualizacije softverskim alatom CiteSpace II napravljena je bibliometrijska analiza istraživanja nusproizvoda prehrambene industrije objavljenih u časopisima koji su indeksirani u citatnim indeksima Web of Science Core Colection baze podataka kako bi se uočili i objasnili razvojni trendovi u znanstvenoj literaturi.

Analizom rezultata utvrđeno je da je zanimanje znanstvenika za istraživanja o korištenju nusproizvoda prehrambene industrije u stalnom porastu, a trend rasta od 2015. se intenzivirao. Istraživanja se provode na znanstvenim institucijama diljem svijeta, Španjolska (13 %) i Italija (11 %) su predvodnici u objavljivanju rezultata istraživanja o korištenju nusproizvoda prehrambene industrije. Također je utvrđeno da znanstvenici rezultate istraživanja objavljuju u znanstvenim časopisima s visokim faktorom odjeka i kvartilima, a isto tako u svojim istraživanjima koriste literaturne reference iz sličnih ili istih naslova u kojima objavljuju.

Ključne riječi: bibliometrija, CiteSpace II, istraživački trendovi, nusproizvodi prehrambene industrije

BIBLIOMETRIC ANALYSIS OF SCIENTIFIC RESEARCH REGARDING FOOD INDUSTRY BY-PRODUCTS IN THE PERIOD 1976 - 2021

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poster presentation

Rising emission of greenhouse gasses, greenhouse effect and pollution resulted in raising interest in sustainable production and reducing human influence on the environment. European Union is aiming at "zero influence" on the environment, as depicted in the Strategy "European Green Deal". Industry is requested to tranfer to sustainable technologies, sustainable products and minimize the emmissions into the environment. New trends and strategic goals led to transition from perceiving food industry by-products as a waste to treateing them as valuable raw materials. This provoked constant raise in the scientific research regarding food industry by-products. The aim of this research was to establish focal points and directions of scientific research regarding food industry by-products. Bibiliometric analyysis was conducted through descriptive bibliometrics and visualisation by CiteSpace II software of the scientific research published in the scientific journals indexed in Web of Science Core Collection, to depict and describe develpoment trends in the scientific literature.
The results showed that the scientific interest in the food industry by-products constantly rises, with significant intensifing from 2015. Research is conducted world-wide, with Spain (13%) and Italy (11%) leading in the number of results. It was also established that scientific results are published in scientific journals with large impact factors and quartilles, using the references of the same, high quality, published in the same or similar journals.

Keywords: bibliometrics, CeteSpace II, research trend, food industry by-products

POTENCIJAL ISKORIŠTENJA NUSPROIZVODA IZ PROIZVODNJE KRUMPIROVOG ŠKROBA

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Glavni predstavnik polisaharida je škrob, koji se zbog svoje široke primjene u industrijama nastoji maksimalno izolirati iz namirnica zbog svog velikog potencijala. Jedna od namirnica bogata škrobom je krumpir, koji se zbog relativno visokog udjela škroba koristi za njegovu proizvodnju. Industrija proizvodnje škroba ima za cilj dobiti što veći prinos škroba, a taj je proces dosta složen i zahtjevan te uključuje niz koraka. Tijekom prerade krumpira u škrob nastaje značajna količina nusproizvoda, čije zbrinjavanje predstavlja velik problem i trošak industriji, ali i mogućnost za postizanje bolje isplativosti procesa iskorištenjem. Nusproizvodi prehrambene industrije su bogati bioaktivnim i nutritivnim tvarima koje pogoduju ljudskom zdravlju, a dostupni su u velikim količinama te uglavnom predstavljaju problem u prehrambenoj industriji, a njihova primjena u razvoju novih proizvoda predstavlja izvrstan potencijal. Glavni nusproizvodi dobiveni iz krumpirovog škroba su proteini i vlakna, koji se najčešće koriste kao stočna hrana.

Ključne riječi: krumpir, škrob, proteini, vlakna

POTENTIAL OF UTILIZATION OF BY-PRODUCTS FROM POTATO STARCH PRODUCTION

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poster presentation

The main polysaccharide is starch, which due to its wide application in industry strives to isolate itself from food as much as possible due to its great potential. One of the foods rich in starch are potatoes, which are used for its production due to the relatively high proportion of starch. The starch production industry aims to obtain the highest possible starch yield. This process is quite complex and demanding and involves a number of steps. During the processing of potatoes into starch, a significant amount of by-products are created, the disposal of which is a big problem and cost to the industry, but also an opportunity to achieve better profitability of the process through utilization. By-products of the food industry are rich in bioactive substances and nutrients that are beneficial to human health, they are available in large quantities and are mainly a problem in the food industry, but their application in the development of new products has great potential. The main by-products derived from potato starch are proteins and fiber most commonly used as animal feed.

Keywords: potato, starch, proteins, fibers

ŽITARICE I NUSPROIZVODI ŽITARICA – MIKOTOKSINI KAO SKRIVENA PRIJETNJA SIGURNOSTI HRANE

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Žitarice i nusproizvodi prerade žitarica su tema od interesa za industriju proizvodnje hrane i hrane za životinje širom svijeta, ponajviše radi nutritivne vrijednosti te tvari koje doprinose zdravlju. Međutim, tema kontaminacije žitarica mikotoksinima, ali i proizvoda koji sadrže žitarice, izaziva zabrinutost sa stajališta zdravstvene ispravnosti proizvoda budući da mikotoksini izazivaju različite nepoželjne toksikološke učinke, potencijalno aditivne ili sinergističke u slučaju njihove supojavnosti, pri čemu imaju negativan učinak na globalnu ekonomiju i međunarodnu trgovinu.
Pojavnost mikotoksina i točne koncentracije još uvijek se ne mogu jasno predvidjeti, budući da ovise ne samo o geografskom području nego i o uvjetima u sezoni i lokalnim vremenskim uvjetima tijekom faza rasta biljke, a sve u trenutku rastućeg negativnog utjecaja klimatskih promjena.
Na distribuciju i koncentraciju mikotoksina utjecaj imaju i postupci prerade žitarica, a pojedine frakcije koje se dobivaju preradom i koriste kao hrana za životinje mogu sadržavati značajne koncentracije mikotoksina, čime se omogućava njihova distribucija kroz cijeli hranidbeni lanac. Takav učinak prijenosa izaziva neočekivane i neželjene zdravstvene rizike koji nastaju kao posljedica konzumacije različite hrane životinjskog podrijetla, poput mlijeka i mliječnih proizvoda te tradicionalnih sušenih mesnih proizvoda.
Dodatna opasnost za sigurnost hrane je i pojavnost modificiranih oblika mikotoksina, često popraćena i sa zakonom nereguliranim mikotoksinima što predstavlja poseban izazov analitičarima u određivanju stvarne razine kontaminacije sirovina i proizvoda.
Kao potencijalno rješenje opisanog problema u svrhu povećanja sigurnosti hrane i hrane za ishranu životinja nameću se strategije prevencije inicijalne kontaminacije te kontinuirano praćenje pojavnosti mikotoksina uz primjenu adekvatnih analitičkih tehnika i metoda.

Ključne riječi: sigurnost hrane, nusproizvodi žitarica, pojavnost mikotoksina, prerada hrane i hrane za životinje, modificirani mikotoksini

CEREALS AND CEREAL BY-PRODUCT`S SAFETY – A HIDDEN MYCOTOXIN THREAT

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poster presentation

Cereals and cereal by-products are a worldwide topic of interest for the food and feed industry, considering its nutritional value and health-promoting components. On the other hand, a well documented co-contamination of mycotoxins in various cereal-based food and feed products represent a health concern due to their adverse toxicological effects, potentially additive or synergistic, while also negatively affecting economy and international trade.
Mycotoxin occurrence and concentration still cannot be clearly predicted, since dependent on not just geographical area but seasonal and local weather conditions during critical plant growing stages, heavily under the impact of climate change effects.
Moreover, cereals processing steps may affect mycotoxin distribution and concentrate mycotoxins into fractions that are commonly used as animal feed, causing mycotoxin transfer along the food production chain. This carry-over effect may bring the unexpected health risk from consuming various foods of animal origin, such as milk and dairy products or traditional dry-cured meat products.
Additionally, the formation of mycotoxin modified forms, along with emerging mycotoxin presence, is another issue, posing an analytical challenge for proper determination of total mycotoxin contamination level.
Initial contamination prevention strategies, but also continuous monitoring and proper analytical solutions, are of great importance for ensuring the safety of cereal by-products intended for further use.

Keywords: food safety, cereal by-products, mycotoxin occurrence, food- and feed processing, modified mycotoxin forms

INTENSIFICATION OF EXTRACTION OF ORANGE PEEL (*Citrus sinensis* L.) HERBAL DUST USING ULTRASONIC PROBE

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Orange peel waste (OPW), as a by-product of citrus processing, can be efficiently valorized and used in the production of filter tea. However, during the industrial processing of this material, a large amount of powder of particle size <0.315 mm is generated, being ultimately disposed. This fraction also called herbal dust or orange peel powder (OPP) is a raw material from which a wide range of bioactive compounds (polyphenols, carotenoids, dietary fiber, sugars, essential oils, etc.) can be isolated. Ultrasound-assisted extraction (UAE) is considered as inexpensive, simple and efficient extraction technique for obtaining extracts of better and more uniform composition in a significantly shorter time and lower energy consumption. Therefore, the efficiency of UAE with an ultrasonic probe for isolation of polar compounds from OPP was examined. During the UAE process, the temperature was defined as a constant (50ºC), and the sonication amplitude (20-100%) was varied. Changes in extraction time, ultrasonic power and energy consumption were observed. Chemical composition was assesed by HPLC. The dominant compounds identified were hesperidin, naringin, narirutin and rutin. The content of all compounds was the highest at the highest amplitude (100%), with hesperidin standing out as the most dominant compound. The results show that UAE using ultrasonic probe can significantly enhance extraction of valuable compounds from plant material thus proving to be a value addition process and potentially efficient technique to be used at industrial level.

Keywords: orange peel, herbal dust, ultrasound-assisted extraction, bioactive compounds

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ISPITIVANJE OSNOVNIH KARAKTERISTIKA VODENIH OTOPINA VLAKANA ŠEĆERNE REPE, PEKTINA ŠEĆERNE REPE I OSA MALTODEKSTRINA

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Specifične karakteristike vodenih otopina polisaharida, dobivenih kao nusproizvoda prehrambene industrije, vrlo su važne u ciljanoj primjeni u formulaciji prehrambenih emulzija. Vlakna šećerne repe, unatoč relativno velikoj godišnjoj proizvodnji, nisu bila u fokusu studija stabilizacije emulzije ili temeljnih strukturnih istraživanja. U ovom istraživanju provedena je temeljna detaljna karakterizacija vodenih otopina vlakana šećerne repe u odnosu na pektin šećerne repe i OSA maltodekstrin kroz analizu kondukcije, viskoznosti, površinski aktivnih svojstava i analizu komponenti. Konduktometrijskim mjerenjima posebno su procijenjene inter- i intramolekularne interakcije između istraživanih polisaharida iz nusproizvoda. U vodenim otopinama vlakana šećerne repe uočena su značajna površinski aktivna svojstva i mali utjecaj na viskoznost vodenih otopina. Najveći utjecaj na vrijednosti viskoznosti otopine pokazale su vodene otopine pektina šećerne repe. Interakcije između molekula maltodekstrina OSA i složene strukture vlakana šećerne repe otkrivene su i raspravljane u konduktometrijskim studijama. Vlakna šećerne repe u prisutnosti pektina šećerne repe pokazala su ubrzano povećanje vrijednosti specifične provodljivosti što ukazuje na učinak suprotan od prethodno objavljenih rezultata vezanih za interakcije polisaharida. Slične vrijednosti površinske napetosti zabilježene su za uzorke OSA maltodekstrina i vlakana šećerne repe. Prijavljeni sadržaj fenolne kiseline mogao bi značajno utjecati na amfifilna svojstva vlakana šećerne repe.

Ključne riječi: vlakna šećerne repe, polisaharid, interakcije, viskoznost

INVESTIGATION OF FUNDAMENTAL CHARACTERISTICS OF AQUEOUS SOLUTIONS OF SUGAR BEET FIBERS, SUGAR BEET PECTIN AND OSA STARCH MALTODEXTRIN

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poster presentation

Specific characteristics of polysaccharide aqueous solutions, obtained as a food industry byproducts, are highly important in the targeted application in food emulsion formulation. Sugar beet fibers, despite relatively large annual production, haven't been in the focus of emulsion stabilization studies or fundamental structural investigation. In this study, fundamental detailed characterization of sugar beet fibers aqueous solutions in comparison to sugar beet pectin and OSA maltodextrin was performed through the analysis of conductivity, viscosity, surface active properties and component analysis. Particularly, inter- and intramolecular interactions between investigated byproducts polysaccharides were evaluated through conductometric measurements. Significant surface active properties and small effect on the viscosity of aqueous solutions was noticed in sugar beet fibers aqueous solutions. Sugar beet pectin aqueous solutions showed the biggest influence on solutions viscosity values. Interactions between OSA maltodextrin molecules and sugar beet fibers complex structure is detected and discussed in conductometric studies. Sugar beet fibers in the presence of sugar beet pectin showed accelerated increase in specific conductivity values indicating effect opposite to previously reported results regarding polysaccharide interactions. Similar surface tension values were reported regarding OSA maltodextrin and sugar beet fibers samples. Reported phenolic acid content could have significant impact on amphiphilic properties of sugar beet fibers.

Keywords: sugar beet fibers, polysaccharide, interactions, viscosity

OVČJA VUNA NIŽE KVALITETE KAO POTENCIJALNO DRAGOCJENA SEKUNDARNA SIROVINA

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Ovčja vuna je nusproizvod uzgoja ovaca i tekstilne industrije bogat keratinom. Zbog složene strukture keratina, ovaj otpad je prilično otporan na razgradnju i predstavlja ozbiljan ekološki problem. Otpadna se vuna često konvertira u različite hidrolizate koji se uglavnom pripremaju ekološki neprikladnim fizikalno-kemijskim tretmanima što rezultira uništavanjem nekih aminokiselina i gubitkom energije. Korištenje biotehnoloških pristupa, kao što su mikrobna ili enzimska predobrada i kompostiranje, može značajno smanjiti utjecaj na okoliš i proizvesti korisne proizvode, kao što su gnojiva i/ili supstrati za proizvodnju bioplina te proizvodi visoke dodane vrijednosti (peptidi, aminokiseline i keratinolitički enzimi). U ovom predavanju uspoređuju se različiti načini prerade i recikliranja otpadne vune, s naglaskom na biotehnološke primjene.

Ključne riječi: vuna, recikliranje, keratin vune, keratinolitički mikroorganizmi; hidrolizat vune

LOWER QUALITY SHEEP WOOL AS A POTENTIALLY VALUABLE SECONDARY RAW MATERIAL

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poster presentation

Sheep wool is a by-product of sheep breeding and the textile industry rich in keratin. Due to the complex structure of keratin, this waste is quite resistant to decomposition and represents a serious environmental problem. Waste wool is often converted into various hydrolysates, which are mainly prepared by environmentally unsuitable physico-chemical treatments, resulting in the destruction of some amino acids and energy loss. The use of biotechnological approaches, such as microbial or enzymatic pretreatment and composting, can significantly reduce environmental impact and produce useful products, such as fertilizers and / or substrates for biogas production, and high value-added products (peptides, amino acids and keratinolytic enzymes). In this lecture, different ways of processing and recycling waste wool is compared, focused on biotechnological applications.

Keywords: wool, recycling, wool keratin, keratinolytic microorganisms; wool hydrolyzate

REZULTATI EFSA-inog PROJEKTA O UTJECAJU KRUŽNOG GOSPODARSTVA NA SIGURNOST HRANE, HRANE ZA ŽIVOTINJE I OKOLIŠA

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U ožujku 2020. godine Europska Komisija (EK) usvojila je novi akcijski plan kružnog gospodarstva (KG) s ciljem smanjenja opterećenja na prirodne resurse, zaustavljanja gubitka biološke raznolikosti i postizanja klimatske neutralnosti Europske unije do 2050. godine. Već do 2030. godine EK planira prepoloviti rasipanje hrane po stanovniku na razini maloprodaje i potrošača, čime će nastojati smanjiti gubitke hrane duž cijelog lanaca proizvodnje i opskrbe hranom. Poštujući odrednice Strategije od "polja do stola" EK će izraditi pravno obvezujuće ciljeve za smanjenje rasipanja hrane do 2023. godine, a u navedene aktivnosti je uključena i Europska agencija za sigurnost hrane (EFSA). EFSA je provela dvogodišnji projekt (2021. - 2022.) pod nazivom „Osjetljivost sigurnosti hrane i hrane za životinje u kontekstu kružnog gospodarstva" i izvršila opsežan pregled znanstvene i stručne literature, tekućih i završenih istraživačkih projekata, kako bi prikupila i procijenila dokaze o kritičnim točkama KG i njegovom utjecaju na sigurnost hrane i hrane za životinje, zdravlje biljaka, životinja i ljudi te okoliš. Obrađena su tri specifična cilja. Prvi cilj odnosio se na identifikaciju i kategorizaciju trenutnih i predviđenih praksi KG unutar svih faza lanca proizvodnje hrane i hrane za životinje na razini Europe unije. Drugi cilj je identificirao nove rizike za zdravlje ljudi, životinja, biljaka i okoliša vezanih za KG, koji proizlaze iz novih opasnosti te novih puteva izloženosti koji mogu dovesti do povećane izloženosti. U okviru trećeg cilja bilo je potrebno karakterizirati identificirane rizike u nastajanju pružanjem dostupnih informacija koje opravdavaju definiciju rizika u nastajanju, relevantnih za EFSA-ino određivanje prioriteta i aktivnosti u području procjene rizika. Rad prikazuje pregled identificiranih makro područja unutar kojih se predviđaju ili se trenutno koriste prakse KG u Europi. Navedena makro područja odnose se na primarnu proizvodnju hrane i hrane za životinje, smanjenje industrijskog/proizvodnog/prerađenog otpada, smanjenje otpada hrane i hrane za životinje u veleprodaji, maloprodaji, ugostiteljstvu i kućanstvima i smanjenje otpada od ambalaže. U radu će se predstaviti zaključci i preporuke za daljnja istraživanja, korištenje jedinstvene terminologije KG i korištenje alata za istraživanje rizika u nastajanju.

Ključne riječi: kružno gospodarstvo, sigurnost hrane, rizici u nastajanju, izloženost

RESULTS OF EFSA'S PROJECT ON IMPACT OF CIRCULAR ECONOMY ON FOOD, FEED AND ENVIRONMENTAL SAFETY

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poster presentation

In March 2020, the European Commission (EC) adopted a new Circular Economy (CE) action plan with the aim to reduce burden on natural resources, to stop the loss of biodiversity and to achieve climate neutrality of the European Union by 2050. Already, until 2030 EC have plan to halve food waste per capita at retail and consumer levels, in an effort to reduce food losses along entire food production and supply chain. Respecting determinants of Farm to Fork Strategy, EC will develop legally binding targets for reducing food waste by 2023 and the European Food Safety Authority (EFSA) is also involved in these activities. EFSA carried out a two-year project (2021-2022) entitled "Food and feed safety vulnerabilities in the circular economy" and conducted a comprehensive review of scientific and professional literature, ongoing and completed research projects, in order to collect and evaluate evidence of critical points of CE and its impact on food and feed safety, plant, animal and human health and the environment. Three specific objectives are addressed. The first objective was to identify and categorize current and projected CE practices within all stages of food and feed production chain at European Union level. The second objective had identified new risks to human, animal, plant and environmental health related to CE, arising from new hazards and new routes of exposure that may lead to increased exposure. Under third objective, it was necessary to characterize identified emerging risks by providing available information that justifies definition of emerging risks, relevant to EFSA's prioritization and risk assessment activities.

The paper provides an overview of identified macro-areas within CE practices in Europe which are envisaged or currently used. These macro-areas are relating to the primary production of food and feed, reduction of industrial/production/processing waste, reduction of food and feed waste in wholesale, retail, catering and households and reduction of packaging waste. The paper will present conclusions and recommendations for further researches, use of unique CE terminology and use of tools for emerging risk research.

Keywords: circular economy, food safety, emerging risks, exposure

RAZVOJ NOVIH PROIZVODA OD SJEMENKE MAKA

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Cilj ovog rada je ispitivanje utjecaja procesnih parametara prešanja sjemenki maka na efikasnost proizvodnje hladno prešanog makovog ulja te njegovu kvalitetu. Prilikom prešanja mijenjani su procesni parametri: brzina pužnice (frekvencija elektromotora) i nastavak za izlaz pogače. Prešanje je provedeno s kontinuiranom pužnom prešom. Primjenom standardnih metoda određeni su osnovni parametri kvalitete proizvedenog hladno prešanog makovog ulja. Također je ispitivan utjecaj dodatka antioksidanasa i mikrovalnog zagrijavanja (vrijeme tretiranja, snaga uređaja) na promjenu oksidacijske stabilnosti proizvedenog makovog ulja. Kao prirodni antioksidansi korišteni su: ekstrakt ružmarina tip Oxy'Less CS, ekstrakt zelenog čaja, ekstrakt nara i sintetski antioksidans propil galat. Određivanje oksidacijske stabilnosti makovog ulja provedeno je testom ubrzane oksidacije Schaal oven testom, a rezultat oksidacije ulja izražen je peroksidnim brojem. U radu je provedeno i ispitivanje utjecaja parametara homogenizacije na promjenu reoloških svojstava i teksture namaza izrađenog od pogače maka (nusproizvod prešanja). Rezultati ispitivanja pokazuju da procesni parametri prešanja utječu na iskorištenje ulja. Najbolje antioksidacijsko djelovanje kod makovog ulja pokazala je primjena ekstrakta zelenog čaja. Procesni parametri homogenizacije utječu na promjenu reoloških svojstava namaza izrađenog od pogače maka, kao i na teksturu namaza.

Ključne riječi: makovo ulje, hladno prešanje, oksidacijska stabilnost, antioksidansi, reološka svojstva namaza

DEVELOPMENT OF NEW PRODUCTS FROM POPPY SEEDS

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poster presentation

The aim of this study was to examine the influence of process parameters of poppy seed pressing on the production efficiency of cold-pressed poppy oil and its quality. During pressing, the process parameters were changed: the screw speed (frequency of the electric motor) and the extension for the cake output. Pressing was performed with a continuous screw press. By applying standard methods, the basic quality parameters of the produced cold-pressed poppy oil were determined. The influence of antioxidant addition and microwave heating (treatment time, device power) on the change of oxidative stability of the produced poppy oil was also investigated. As natural antioxidants were used: rosemary extract type Oxy'Less CS, green tea extract, pomegranate extract and synthetic antioxidant propyl gallate. Determination of the oxidative stability of poppy oil was performed by the accelerated oxidation test Schaal oven test, and the result of oil oxidation was expressed by peroxide number. The study also investigates the influence of homogenization parameters on the change of rheological properties and texture of spreads made from poppy seed cake (by-product of pressing). The obtained results showed that the pressing process parameters affect the oil yield. The best antioxidant effect in poppy oil was shown by the use of green tea extract. The process parameters of homogenization affect the change of rheological properties and texture of the spread made from poppy seed cake.

Keywords: poppy seed oil, screw pressing, oxidation stability, antioxidants, rheological properties and texture of spreads

UTJECAJ EKSTRUDATA TROPA JABUKE NA SENZORSKE KARAKTERISTIKE ČAJNOG PECIVA

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Trop jabuke čini skoro 25 % ukupne mase jabuke koja ostane nakon prerade. Prije svega je bogat prehrambenim vlaknima (35-60 %), sadrži značajne količine topljivih prehrambenih vlakana, uglavnom pektina. Cilj ovog istraživanja bio je ispitati utjecaj zamjene 5, 10 i 15 % pšeničnog brašna ekstrudatima obogaćenim tropom jabuke (omjer kukuruzne krupice : tropa jabuke 85:15), na senzorske karakteristike čajnog peciva. Uzorke čajnog peciva je ocijenio panel od 10 obučenih ocenjivača. Intenzitet svakog svojstva je naveden na skali intenziteta od 7 bodova. Ocjenjivania svojstva bila su: boja, izgled površine, tvrdoća, zrnatost, izgled pora i okus. Tvrdoća čajnog peciva, zrnatost i broj pukotina na površini su se povećavali s povećanjem sadržaja ekstrudata. Dodavanjem ekstrudata obogaćenih tropom jabuke čajno pecivo je dobilo karakterističnu voćnu aromu i tamniju boju s povećanjem udjela crvenog tona. Također, intenzitet okusa jabuke se povećavao s povećanjem sadržaja ekstrudata. Zbog ugodne arome ovog tropa, moguće je smanjiti količinu šećera u čajnom pecivu.

Ključne riječi: trop jabuke, valorizacija nusproizvoda, kvaliteta čajnog peciva, senzorska analiza

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THE INFLUENCE OF APPLE POMACE EXTRUDATES ON COOKIES SENSORY CHARACTERISTICS

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poster presentation

Apple pomace make almost 25% of the total weight of apple left over after processing. It is primarily rich in dietary fiber (35-60%), contains significant amounts of soluble dietary fiber, mostly pectin. The aim of this study was to examine the effect of replacing 5, 10 and 15% of wheat flour with extruded snack products enriched with the apple pomace (corn grit:apple pomace ratio was 85:15), on the sensory characteristics of cookies. Cookie samples were evaluated by a panel of 10 trained members. The intensity of each attribute is listed on a 7-point intensity scale. The evaluated attributes were: color, surface appearance, hardness, graininess, pore appearance and taste. The hardness of cookies, graininess and number of cracks in the surface increased with increasing extrudate content. By adding apple pomace extrudates, the cookies get a characteristic fruity aroma and a darker color with increasing the share of red tone. Also, the intensity of the apple taste increased with the increase of the extrudate content. Due to the pleasant aroma of this pomace, it is possible to reduce the amount of sugar in the cookies.

Keywords: apple pomace, food waste valorization, cookie quality, sensory analysis

The research was financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No. 451-03-68/2022-14/200134.

TRŽIŠTE KUKACA

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Nagomilavanje biootpada predstavlja velik problem te se konstantno traže ekonomski i ekološki prihvatljiva rješenja. Uključivanje kukaca u proces razgradnje biootpada te stvaranje novih proizvoda iz novonastale sirovine nudi se kao jedno od riješenja. Kroz proces kružne ekonomije pokušavaju se iskoristiti svi resursi kako bi se uspostavila ravnoteža u prirodi koja će biti i ekonomski isplativa. Uključivanjem kukaca u proces razgradnje značajno se može reducirati velika količina biootpada zatvarajući proces stvaranjem novih proizvoda. Najznačajnije vrste kukaca koje se uključuju u proces prerade biootpada su: crna vojnička muha (*Hermetia illucens,* L.), kućna muha (*Musca domestica,* L.) i veliki brašnar (*Tenebrio molitor,* L.). U zadnjem desetljeću se ovi kukci intenzivno proučavaju radi mogućnosti njihovog iskorištavanja u različitim granama industrije kao što su: prehrambena, farmaceutska, kozmetička. Velika je mogućnost njihove prerade i implementacije u poljoprivredi kroz dobivanje stočne hrane visoke vrijednosti i biognojiva kao i za dobivanje biogoriva u automobilskoj industriji. Na tržištu već postoji velik broj komercijalnih proizvoda dobivenih od kukaca ili njihovih nusproizvoda. Najveću primjenu nalazi u akvakulturi kao zamjena za bjelančevine, ali i općenitoj kao hrana za razne životinjske vrste koja čini idealnu zamjenu za sojino brašno. Osim hrane za životinje koriste se i u ljudskoj ishrani, za proizvodnju biodizela, kozmetičke proizvode kao i organska gnojiva koja imaju široku primjenu. Iako je tržište kukaca prilično razvijeno, još uvijek ne može cijenama konkurirati konvencionalnim proizvodima. U svijetu postoji velik broj tvrtki koje se bave proizvodnjom, preradom i distribucijom kukaca i njihovih proizvoda koje ostvaruju milijunske prihode i u budućnosti se predviđa konstantan rast ovog tržišta.

Ključne riječi: biootpad, kukci, kružna ekonomija, tržište proizvoda od kukaca

INSECT MARKET

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poster presentation

The accumulation of biowaste is a major problem and economically and ecologically acceptable solutions are needed. The use of insects in the decomposition process and the creation of new products from newly formed raw materials is offered as one of the solutions. Through the process of circular economy, an attempt is made to use all resources to establish a balance in nature that is also economically viable. By including insects in the decomposition process, a large amount of biowaste can be significantly reduced, completing the process of creating new products. The most important insect species involved in biowaste processing are the black soldier fly (*Hermetia illucens*, L.), the house fly (*Musca domestica*, L.) and mealworm (*Tenebrio molitor*, L.). In the last decade, these insects have been intensively studied for the possibility of their use in various industries such as food, pharmaceuticals and cosmetics. Their processing and application in agriculture for the production of high-quality animal feed and biofertilizers, as well as for the production of biofuels for the automotive industry, is very promising. There are already a large number of commercial products derived from insects or their by-products. It is most widely used in aquaculture as a protein substitute, but also in general as food for various animal species, making it an ideal substitute for soy flour. They are also used in human nutrition, for the production of biodiesel, cosmetic products, and organic fertilizers that are widely used. Although the insect market is quite developed, it still cannot compete with conventional products in terms of prices. In the world, there are a large number of companies involved in the production, processing and distribution of insects and their products, which generate millions of revenues, and constant growth of this market is predicted in the future.

Keywords: biowaste, insects, circular economy, insect market

MOGUĆNOST ISKORIŠTENJA KRUMPIROVOG ŠKROBA - NUSPROIZVODA IZ PROIZVODNJE ČIPSA

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Tržište snack proizvoda, posebice onih koji sadrže krumpir u nekom obliku, u stalnom je porastu, usprkos općoj percepciji kako se radi o proizvodima koji imaju veliku kalorijsku, ali malu nutritivnu vrijednost. Ipak, brojna su istraživanja kojima je cilj povećati nutritivnu vrijednost ove skupine proizvoda, ali također unaprijediti postojeće proizvodne procese kako bi se iskoristili nusproizvodi koji nastaju tijekom proizvodnje, a često nisu na odgovarajući način valorizirani. Jedan od takvih nusproizvoda je krumpirov škrob koji zaostaje u vodi koja se koristi tijekom prve faze tehnološkog procesa proizvodnje čipsa, na tzv. zelenoj liniji, gdje se odvija proces pranja i guljenja krumpira te rezanje krumpira na listiće. Otpadna voda koja zaostaje nakon pranja krumpirovih listića bogata je škrobom, što za posljedicu ima njezino veliko organsko opterećenje te je takvu vodu potrebno pročistiti prije ispuštanja u sustave odvodnje ili u okoliš. Ipak, škrob prisutan u otpadnoj vodi ima potencijal za daljnju primjenu, ako se uspješno izdvoji iz otpadne vode, dok se pročišćena otpadna voda može ponovo koristiti u proizvodnom procesu kao tehnološka voda za primjerice ispiranje oguljenih gomolja na gulilicama. U radu će se dati prikaz postupaka za izdvajanje škroba iz otpadne vode, kao i mogućnosti daljnjeg iskorištenja dobivenog škroba, poput proizvodnje modificiranih škrobova za daljnju primjenu u prehrambenoj industriji, kao ugušćivač u gastronomiji, kao punilo u proizvodnji lijekova, kao hranjivo za bakterije tijekom proizvodnje komposta, za proizvodnju škrobnog ljepila, proizvodnju etanola, u bioplinskim postrojenjima za dobivanje toplinske ili električne energije i drugo.

Ključne riječi: krumpirov škrob, izdvajanje škroba, nusproizvod proizvodnje krumpirovog čipsa

POSSIBILITY OF USING POTATO STARCH - BY-PRODUCT FROM POTATO CHIPS PRODUCTION

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poster presentation

The market for snack products, especially those containing potatoes in some form, is constantly growing, despite the general perception that they are high in calories but low in nutritional value. Nevertheless, there are numerous studies aimed at increasing the nutritional value of this group of products, but also at improving the existing production processes in order to reuse the by-products generated during production, which are often not properly valorized. One of these by-products is potato starch, which remains in the water used in the first phase of the technological process of potato chip production, the so-called "green line", in which the washing and peeling of the potatoes and the slicing of the potatoes take place. The wastewater that remains after washing the potato slices is rich in starch and therefore has a high organic load. Therefore, it must be treated before it is discharged into the sewer system or the environment. However, the starch contained in the wastewater has the potential for further use if it is successfully separated from the wastewater, while the treated wastewater can be reused in the production process as process water, for example for rinsing the peeled tubers. This work gives an overview of the processes for separating starch from wastewater and the possibility of further use of the recovered starch, such as the production of modified starch for further use in the food industry, as a thickener in gastronomy, as a filler in pharmaceuticals, as a nutrient for bacteria in the production of compost, for the production of starch glue, for the production of ethanol, in biogas plants for the production of heat or electricity, and others.

Keywords: potato starch, starch separation, by-product from potato chips production

VALORIZATION OF ROSEHIP (*Rosa canina*) FOOD INDUSTRY BY-PRODUCT USING GREEN SOLVENTS

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poster presentation

Rosehip (*Rosa canina* L.) represents a very important commercially traded medicinal plant used in the production of different food products such as marmalade, jam, beverages, jelly, syrup, and tea. During production, substantial amounts of by-products that can contain pericarp and seeds are generated. These materials have bioactive components such as pigments, fatty acids, and polyphenols which have applications in the pharmaceutical, food, and cosmetic industries.
In this study, by-products were used from the beverages industry, rosehip seeds (RS), and herbal dust (RHD) which is a filter tea industry by-product with a particle diameter smaller than the diameter of a filter bag pore size (less than 0.315 mm).
To achieve a rational use of these by-products, green solvents supercritical carbon dioxide ($ScCO_2$) and deep eutectic solvents (DES) were used. For the extraction of lipophilic compounds, $ScCO_2$ extraction was conducted under the following conditions: pressure 300 bar, temperature 40 °C, and extraction time 4h. The extraction yield equaled 4.06% for RS, whereas the RHD extraction yield was 5.42%. After removing the lipophilic fraction, the material was further used in the ultrasound-assisted extraction with DES. The ultrasound-assisted extraction was performed at two temperatures (40 and 60 °C) and three extraction times (30, 60, and 90 min) with DESs of different polarities. Obtained extracts were characterized in terms of antioxidant capacity and content of pigments and polyphenolic compounds. It was determined that RS represent an excellent source of bioactive compounds and that green solvents can convert them into highly valuable products.

Keywords: *Rosa canina*, supercritical carbon dioxide, deep eutectic solvents

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