Flour - Bread '19 : Book of Abstracts 10th International Congress Flour - Bread '19 and 12th Croatian Congress of Cereal Technologists Brašno - Kruh '19

ISSN 1848-2554

10th INTERNATIONAL CONGRESS

FLOUR–BREAD ’19

12th CROATIAN CONGRESS OF CEREAL TECHNOLOGISTS

BRAŠNO–KRUH ’19.

OSIJEK, CROATIA

June 11-14, 2019

BOOK OF ABSTRACTS

ORGANISED BY

JOSIP JURAJ STROSSMAYER UNIVERSITY OF OSIJEK
FACULTY OF FOOD TECHNOLOGY OSIJEK - PTFOS

CROATIAN AGENCY FOR AGRICULTURE AND FOOD – HAPIH

INTERNATIONAL ASSOCIATION FOR CEREAL SCIENCE AND TECHNOLOGY - ICC

ISEKI-FOOD ASSOCIATION – IFA

GLOBAL HARMONIZATION INITIATIVE – GHI

Published by
JOSIP JURAJ STROSSMAYER UNIVERSITY OF OSIJEK
FACULTY OF FOOD TECHNOLOGY OSIJEK

Editors
Antun Jozinović
Sandra Budžaki
Ivica Strelec
Ante Lončarić

Proofreading
Antonija Šarić
Lahorka Budić

Cover page
Grafika d.o.o., Osijek

Printed by
Grafika d.o.o., Osijek

Edition
200 copies

UNDER THE AUSPICES OF:

Ministry of Science and Education of the Republic of Croatia

Ministry of Agriculture of the Republic of Croatia

Ministry of Economy, Entrepreneurship and Crafts of the Republic of Croatia

Ministry of Health of the Republic of Croatia

Ministry of Environment and Energy

Josip Juraj Strossmayer University of Osijek

Croatian Chamber of Economy

Croatian Academy of Engineering

Croatian Employers' Association

Osijek-Baranja County

City of Osijek

SUPPORTING PUBLICATION

Croatian Journal of Food Science and Technology (CJFST)

SPONSORS

GOLDEN

Bastak Instruments, Turkey
TIM ZIP d.o.o., Croatia

BRONZE

Ru-Ve d.o.o., Croatia
Labena d.o.o., Croatia
AlphaChrom d.o.o., Croatia
Actor d.o.o., Slovenia

OTHER

Polytechnic in Požega, Croatia

EXHIBITORS

Bastak Instruments, Turkey
TIM ZIP d.o.o., Croatia
Labena d.o.o., Croatia
AlphaChrom d.o.o., Croatia
Ru-Ve d.o.o., Croatia
Brabender GmbH & Co. KG, Germany
Pfeuffer GmbH, Germany
Actor d.o.o., Slovenia
FrigorTec GmbH, Germany
Kefo d.o.o., Croatia
Kemolab d.o.o., Croatia
Ansar-Analitika d.o.o., Croatia
Chopin Technologies, France
MOBULA d.o.o., Croatia
OPSIS AB, Sweden
Unity Scientific GmbH, Germany
Cras d.o.o., Croatia
Wintersteiger AG, Austria

MEDIA SUPPORT

Biscuit People, Croatia
Bakery, Biscuits and Pasta Sector Specialty Magazine (BBM), Turkey
Pekarski Glasnik, Croatia

ORGANIZING COMMITTEE

President: Ivica Strelec, Croatia
Vice-President: Michaela Pichler, Austria
Vice-President: Huub Lelieveld, The Netherlands
Vice-President: Sandra Budžaki, Croatia
Secretary: Antun Jozinović, Croatia

MEMBERS

Jurislav Babić, Croatia
Krunoslav Dugalić, Croatia
Andrea Gross-Bošković, Croatia
Lidija Jakobek, Croatia
Nada Knežević, Croatia
Ante Lončarić, Croatia
Marija Stjepanović, Croatia
Antonija Šarić, Croatia
Zdenko Lončarić, Croatia

SCIENTIFIC COMMITTEE

President: Hamit Köksel, Turkey
Vice-President: Antun Jozinović, Croatia
Vice-President: Gerhard Schleining, Austria
Vice-President: Darja Sokolić, Croatia

MEMBERS

Günter Unbehend, Germany
Daniela Čačić Kenjerić, Croatia
Stela Jokić, Croatia
Cristina Molina Rosell, Spain
Paola Battilani, Italy
Ivana Rukavina, Croatia
Alain Sommier, France
Chathudina Liyanage, Sri Lanka
Ivan Švec, Czech Republic
Tomaž Požrl, Slovenia
Zoltán Győri, Hungary
Dragan Živančev, Serbia
Artur Gryszkin, Poland
Jasna Mastilović, Serbia
Vlado Guberac, Croatia
Daliborka Koceva Komlenić, Croatia
Mirela Planinić, Croatia
Ana Bucić-Kojić, Croatia
Biljana Pajin, Serbia
Marina Tišma, Croatia
Drago Šubarić, Croatia
Daniela Horvat, Croatia
Borislav Miličević, Croatia
Jelka Pleadin, Croatia

INDUSTRIAL ADVISORY BOARD

Dragan Kovačević (HGK), Croatia
Ivan Sarić (HUP), Croatia
Katarina Jukić (BC Institut), Croatia
Darinka Andrašek (Kraš d.d.), Croatia
Zvonimir Zdunić (POLJINOS), Croatia
Dominka Maričić (Inspecto d.o.o.), Croatia

HONOURABLE COMMITTEE

Žaneta Ugarčić, Croatia
Vlasta Piližota, Croatia
Vladimir Andročec, Croatia

Reviewers: Đurđica Ačkar (Croatia), Jurislav Babić (Croatia), Elene Bartkiene (Lithuania), Paola Battilani (Italy), Ana Bucić-Kojić (Croatia), Sandra Budžaki (Croatia), Daniela Čačić Kenjerić (Croatia), Duška Ćurić (Croatia), Bojana Filipčev (Serbia), Ivana Flanjak (Croatia), Daniela Horvat (Croatia), Elizabet Janić Hajnal (Serbia), Antun Jozinović (Croatia), Katarina Jukić (Croatia), Nada Knežević (Croatia), Hamit Köksel (Turkey), Tihomir Kovač (Croatia), Chathudina Liyanage (Sri Lanka), Ante Lončarić (Croatia), Jasna Mastilović (Serbia), Mladenka Pestorić (Serbia), Mirela Planinić (Croatia), Jelka Pleadin (Croatia), Lea Pollak (Croatia), Cristina Molina Rosell (Spain), Alain Sommier (France), Ivica Strelec (Croatia), Bojan Šarkanj (Croatia), Gordana Šimić (Croatia), Ivan Švec (Czech Republic), Marina Tišma (Croatia), Aleksandra Torbica (Serbia), Natalija Velić (Croatia), Dragan Živančev (Serbia).

Table of Contents

SCIENTIFIC PROGRAMME i
POSTER PRESENTATIONS xv
PLENARY LECTURES 1
CEREAL FOOD SAFETY 9
CEREAL PROCESSING TECHNOLOGIES 21
CEREAL WASTE MANAGEMENT 39
CEREALS AND CEREAL PRODUCT QUALITY 49
CEREALS AND CLIMATE CHANGES 81
CEREALS AND HEALTH 87
AUTHOR INDEX 107
SPONSORS AND EXHIBITORS 113

SCIENTIFIC PROGRAMME

SCIENTIFIC PROGRAMME

Tuesday, 11 June 2019

16:00-19:00 Participant registration

Congress Hall "Javor"

RADIONICA/WORKSHOP:

"RECITE DA DONIRANJU HRANE"

"CHOOSE YES FOR FOOD DONATION"

18:00-18:15 Pozdravne riječi organizatora
Workshop organizer addressing

18:15-18:35 NACIONALNA STRATEGIJA SPRJEČAVANJA NASTAJANJA OTPADA OD HRANE TE NOVI ALATI U DONIRANJU HRANE
NATIONAL FOOD WASTE PREVENTION STRATEGY AND NEW TOOLS IN FOOD REDISTRIBUTION
Iva Skelin Paulić, Ministarstvo poljoprivrede, Hrvatska/Ministry of Agriculture, Croatia
Predavanje/Workshop Lecture

18:35-18:55 KAKO SIGURNO RUKOVATI VIŠKOVIMA HRANE?
HOW WE CAN SAFELY HANDLE SURPLUS FOOD?
Andrea Gross-Bošković, Hrvatska agencija za poljoprivredu i hranu, Hrvatska/Croatian Agency for Agriculture and Food, Croatia
Predavanje/Workshop Lecture

18:55-20:00 Rasprava, pitanja i odgovori
Discussion, questions and answers

Exhibition & Refreshment Area

SOCIAL EVENT

20:00-22:00 Welcome Cocktail "*Let's Come Together*"

Wednesday, 12 June 2019

08:00-18:00	**Participant registration**
09:30-10:45	**Opening Ceremony**
10:45-11:15	Coffee Break, Exhibition and Poster Session "Healthy" cookies by TIM ZIP Ltd

Congress Hall "Javor"

Moderators:

Hamit Köksel, Darja Sokolić, Ivica Strelec

11:15-11:25	**GLOBAL EFFECT OF CLIMATE CHANGES** *Food Agriculture Organization (Italy)* *Introductory Movie*
11:25-11:55	**AGROMETEOROLOGICAL MODELING OF CEREAL YIELD IN FUTURE CLIMATE** *Petra Sviličić and Višnjica Vučetić (Croatia)* *Plenary lecture*
11:55-12:25	**FOOD SAFETY IN THE CONTEXT OF CLIMATE CHANGE** *Angelo Maggiore, Jean Lou Dorne, Federica Barrucci, Giacomo De Sanctis, Raquel Garcia Matas, Yves van der Stede, Ana Afonso, Angeliki Konsta (Italy)* *Plenary lecture*
12:25-12:45	**CLIMATE CHANGE ADAPTATION STRATEGY IN THE REPUBLIC OF CROATIA FOR THE PERIOD TO 2040 WITH A VIEW TO 2070** *Branka Pivčević Novak and Marija Vihovanec Sabo (Croatia)* *Invited lecture*
12:45-13:05	**TIM ZIP Ltd** *TIM ZIP (Croatia)* *Sponsor Advertisement Presentation*
13:05-13:20	**Discussion and conclusion**
13:20-14:30	**Break for lunch** **Croissants and pizza croissants by TIM ZIP Ltd**

Congress Hall "Lipa"

13:30-14:30 General GHI meeting

Congress Hall "Javor"

Moderators:
Andrea Gross-Bošković, Daniela Horvat, Sandra Budžaki

14:30-15:00 THE EFFECTS OF CLIMATE CHANGES ON MYCOTOXIN CONTAMINATION – FUTURE THREATS AND CHALLENGES
Jelka Pleadin (Croatia)
Plenary lecture

15:00-15:30 WHEAT BREEDING CHALLENGES REGARDING CLIMATE CHANGES
Krešimir Dvojković, Dario Novoselović, Daniela Horvat, Marko Ivić, Ivana Plavšin, Georg Drezner (Croatia)
Plenary lecture

15:30-15:50 THE EFFECT OF CLIMATE CHANGE ON CEREAL GRAIN QUALITY
Dragan Živančev, Jasna Mastilović, Aleksandra Torbica, Daliborka Koceva Komlenić (Serbia)
Invited lecture

15:50-16:05 MYCOTOXINS: THE IMPACT ON HEALTH AND ANALYTICS
Slađana Rumpl Tunjić, Labena d.o.o. (Croatia)
Sponsor Advertisement Presentation

16:05-16:20 Discussion and conclusion

16:20-16:50 Coffee Break, Exhibition and Poster Session
Doughnuts and cocoa croissants by TIM ZIP Ltd

Congress Hall "Lipa"

RADIONICA/WORKSHOP:

"NOVA PRAVILA ZA OZNAČAVANJE ZEMLJE PODRIJETLA GLAVNOG SASTOJKA HRANE"

"NEW RULES ON THE PROVISION OF INFORMATION ON COUNTRY ORIGIN OF THE PRIMARY INGREDIENT OF THE FOOD"

16:00-16:15	**Pozdravne riječi organizatora** **Workshop organizer addressing**
16:15-17:00	**NOVA PRAVILA ZA OZNAČAVANJE ZEMLJE PODRIJETLA GLAVNOG SASTOJKA HRANE** **NEW RULES ON THE PROVISON OF INFORMATION ON COUNTRY OF ORIGIN OF THE PRIMARY INGREDIENT OF THE FOOD** *Marija Batinić Sermek, Sanja Kolarić Kravar, Jelena Đugum, Ministarstvo poljoprivrede, Hrvatska/Ministry of Agriculture, Croatia* *Predavanje/Workshop Lecture*
17:00-18:00	**Rasprava, pitanja i odgovori** **Discussion, questions and answers**

Congress Hall "Javor"

Moderators:
Dragan Živančev, Katarina Jukić, Ivana Rukavina

16:50-17:10	**QUALITY OF MERCANTILE WHEAT VARIETIES IN REPUBLIC OF CROATIA ACCORDING TO THE CODEX FOR THE PURCHASE OF CEREALS AND OILSEEDS** *Goran Jukić, Ivana Rukavina, Krunoslav Dugalić, Ivan Varnica, Krešimir Šunjić (Croatia)* *Invited lecture*
17:10-17:30	**THE POTENTIAL OF BARLEY FOR BIOFORTIFICATION** *Zdenko Lončarić, Andrijana Rebekić, Gordana Šimić, Ivan Abičić, Darko Kerovec, Alojzije Lalić (Croatia)* *Invited lecture*

17:30-17:45 **COMPLEX COMPARISON OF THE EFFECT OF QUINOA AND CANAHUA WHOLEMEAL FLOURS ON THE QUALITY OF COMMERCIAL WHEAT FLOUR**

Ivan Švec, Marie Hrušková, Taťána Hofmanová, Rasa Kapačinskaitė
(Czech Republic)

Oral presentation

17:45-18:00 **CREATION OF A MILLING PERFORMANCE INDEX (MPI) BASED ON THE BEHAVIOUR OF WHEAT DURING LABORATORY MILLING**

Arnaud Dubat, Chopin Technologies (France)

Sponsor Advertisement Presentation

18:00-18:15 **Discussion and conclusion**

SOCIAL EVENT

19:00-20:30 **Walk'n Through Route 031**

Sightseeing of the City of Osijek

Provided by the Tourist Board of the City of Osijek

Thursday, 13 June 2019

Congress Hall "Javor"

Moderators:

Ivan Švec, Zoltán Győri, Antun Jozinović

09:00-09:30 **A NEW APPROACH IN EXTRUSION COOKING: CO_2 GAS INJECTION**
Hamit Köksel and M. Tugrul Masatcioglu (Turkey)
Plenary lecture

09:30-09:45 **UTILISATION OF EXTRUSION COOKING AND ENZYMATIC HYDROLYSIS TO INCREASE THE SOLUBLE FIBRE CONTENT OF WHEAT BRAN**
Eda Aktas-Akyildiz, M. Tugrul Masatcioglu, Hamit Köksel (Turkey)
Oral Presentation

09:45-10:05 **POTENTIAL PRODUCTION OF NUTRITIONALLY ENRICHED COOKIES USING FOOD INDUSTRY BY-PRODUCTS**
Biljana Pajin (Serbia)
Invited lecture

10:05-10:25 **IMPORTANCE OF RHEOLOGICAL ANALYSIS IN WHEAT FLOUR DOUGH**
Zeki Demirtasoglu and Esra Zeynep Arslan (Turkey)
Sponsor Advertisement Presentation

10:25-10:40 **Discussion and conclusion**

10:40-11:10 Coffee Break, Exhibition and Poster Session
Provided by Cras d.o.o. Osijek, Croatia

Congress Hall "Lipa"

10:00-10:40 **ZAVRŠNA KONFERENCIJA PROJEKTA: "ULAGANJE U INOVATIVNA RJEŠENJA I RAZVOJ NISKOENERGETSKE SUŠARE"**
FINAL CONFERENCE OF THE PROJECT: "INVESTMENT IN INOVATIVE SOLUTIONS AND DEVELOPMENT OF A LOW-ENERGY DRYER"
Cras d.o.o. Osijek, Croatia

Congress Hall "Javor"

Moderators:

Biljana Pajin, Artur Gryszkin, Daniela Čačić Kenjerić

11:10-11:30	**RESISTANT STARCH – AN IDEAL FIBRE FOR THE CEREAL INDUSTRY** *Đurđica Ačkar, Antun Jozinović, Drago Šubarić, Borislav Miličević, Jurislav Babić (Croatia)* *Invited lecture*
11:30-11:45	**EFFECTS OF RESISTANT STARCH TYPE 4 AND WHEAT BRAN ON DOUGH AND BREAD PROPERTIES** *Merve Arıbaş and Hamit Köksel (Turkey)* *Oral presentation*
11:45-12:05	**INTERACTIONS BETWEEN ß-GLUCAN FROM CEREALS AND POLYPHENOLS** *Lidija Jakobek and Andrew R. Barron (Croatia)* *Invited lecture*
12:05-12:20	**β-GLUCAN FROM BARLEY AS AN ADSORBENT OF QUERCETIN** *Jozo Ištuk and Lidija Jakobek (Croatia)* *Oral Presentation*
12:20-12:40	**SUSTAINABLE BOSCH PACKAGING SYSTEMS** *Uwe Pfander, Bosch Packaging Technology (Germany)* *Sponsor Advertisement Presentation*
12:40-12:55	**Discussion and conclusion**
12:55-14:30	**Break for lunch**

Congress Hall "Javor"

Moderators:

Dominika Maričić, Stela Jokić, Ivica Strelec

14:30-15:00	**(RE)CYCLING OF NANOMATERIALS-FROM THE LABORATORY TO THE TABLE AND BACK** *Aleksandar Djordjevic, Danica Jović, Ivana Borišev (Serbia)* *Plenary lecture*
15:00-15:15	**OCCURRENCE OF ACRYLAMIDE AND POLYCYCLIC AROMATIC HYDROCARBONS IN CEREAL BASED BABY FOOD** *Tanja Bogdanović, Sandra Petričević, Eddy Listeš, Darja Sokolić (Croatia)* *Oral Presentation*
15:15-15:35	**ARE THE "GLUTEN FREE" PRODUCTS REALLY GLUTEN FREE?** *Lea Pollak and Andrea Adanić Pajić (Croatia)* *Invited lecture*
15:35-15:55	**THE PREFERENCE OF BREAD, BREAD ROLLS AND BREAKFAST CEREALS DEPENDING ON THE FLOUR TYPE** *Darja Sokolić (Croatia)* *Invited lecture*
15:55-16:15	**NUTRITIVE AND HEALTH ASPECTS OF CEREALS-BASED SNACK PRODUCTS** *Daniela Čačić Kenjerić (Croatia)* *Invited lecture*
16:15-16:35	**PROTECTING THE QUALITY OF GRAIN** *Michael Reitter, Frigortec (Germany)* *Sponsor Advertisement Presentation*
16:35-16:50	**Discussion and conclusion**
16:50-17:20	Coffee Break, Exhibition and Poster Session

Congress Hall "Lipa"

RADIONICA/WORKSHOP:

"KAKO SNIZITI GLIKEMIJSKI INDEKS PROIZVODA NA BAZI ŽITARICA?"

"REDUCTION OF GLYCAEMIC INDEX OF CEREAL BASED PRODUCTS"

17:00-17:15 **Pozdravne riječi organizatora**
Workshop organizer addressing

17:15-17:35 **GLIKEMIJSKI INDEKS KRUHA**
GLYCAEMIC INDEX OF BREAD
Dubravka Novotni, Prehrambeno-biotehnološki fakultet Sveučilišta u Zagrebu, Hrvatska/Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia
Predavanje/Workshop Lecture

17:35-17:45 **MARKETING AURELIA PUNJENE SVJEŽE TJESTENINE SNIŽENOG GLIKEMIJSKOG INDEKSA**
MARKETING OF AURELIA FILLED FRESH PASTA WITH REDUCED GLYCAEMIC INDEX
Zoran Šimunić, Naše klasje d.o.o., Hrvatska/Naše Klasje Ltd, Croatia
Predavanje/Workshop Lecture

17:45-18:05 **GLIKEMIJSKI INDEKS KROZ OČI POTROŠAČA**
GLYCAEMIC INDEX THROUGH THE EYES OF CONSUMERS
Martina Pavlić, Hrvatska agencija za poljoprivredu i hranu, Hrvatska/Croatian Agency for Agriculture and Food, Croatia
Predavanje/Workshop Lecture

18:05-19:00 **Rasprava, pitanja i odgovori**
Discussion, questions and answers

Hotel Osijek Restaurant

SOCIAL EVENT

21:00 **Congress Dinner**

Friday, 14 June 2019

Congress Hall "Javor"

Moderators:

Darinka Andrašek, Lea Pollak, Lidija Jakobek

10:30-10:50	**TRENDS IN FLOUR BASED CONFECTIONARY** *Sanja Oručević Žuljević (Bosnia and Herzegovina)* *Invited lecture*
10:50-11:05	**CHALLENGES OF THE USE OF LACTIC ACID FOR BREAD PREPARATION - COMPARISON STUDY: LACTIC ACID OR LACTO-FERMENTATION** *Vita Lele, Vadims Bartkevics, Iveta Pugajeva, Sigrid Mayrhofer, Konrad Domig, Elena Bartkiene (Lithuania)* *Oral Presentation*
11:05-11:20	**APPLICATION OF *LACTOBACILLI* IN COMBINATION WITH CRANBERRY COATING ON MOULD SPOILAGE PREVENTION AND ACRYLAMIDE REDUCTION IN WHEAT BREAD** *Elena Bartkiene, Vita Lele, Paulina Zavistanaviciute, Vytaute Sakiene, Vadims Bartkevics, Iveta Pugajeva, Daiva Zadeike, Grazina Juodeikiene (Lithuania)* *Oral presentation*
11:20-11:35	**THE IMPORTANCE OF MARKETING IN THE PRODUCTION AND PROCESSING OF CEREALS IN INDUSTRY 4.0** *Branimir Dukić, Stojanka Dukić, Saša Mitrović (Croatia)* *Oral Presentation*
11:35-11:50	**CEREAL BASED FOOD INDUSTRY - ECONOMIC POINT OF VIEW** *Marijana Blažić, Lahorka Halmi, Kornelija Severović (Croatia)* *Oral presentation*
11:50-12:05	**Discussion and conclusion**
12:05-12:30	**Coffee Break**

Congress Hall "Javor"

12:30-13:00	**Congress Closing Ceremony** **10th International "Flour-Bread '19" Congress Jubilee Awards** **Best Poster Awards**

SOCIAL EVENT

14:30-19:30	**Excursion to the Nature Park "Kopački Rit"** *Organized by Travelling Agency*

POSTER PRESENTATIONS

POSTER PRESENTATIONS

CEREAL FOOD SAFETY

P-01 **THE EFFECIENCY OF MODERN MILL INDUSTRY CLEANING SYSTEMS ON MYCOTOXIN AND ALKALOID LEVELS IN CEREALS**
Metka Ačko, Lidija Tašner

P-02 **EFFECT OF THE EXTRUSION PROCESS ON THE MYCOTOXIN CONTENT IN TRITICALE**
Elizabet Janić Hajnal, Janja Babič, Breda Jakovac Strajn, Jovana Kos,Vojislav Banjac, Radmilo Čolović, Katarina Pavšič Vrtač

P-03 **INFLUENCE OF IMMOBILIZED *LACTOBACILLI* IN APPLE POMACE FOR WHEAT - BARLEY BREAD PREPARATION**
Elena Bartkiene, Vita Lele, Donata Vizbickiene, Vadims Bartkevics, Iveta Pugajeva, Paulina Zavistanaviciute, Daiva Zadeike, Grazina Juodeikiene

P-04 **MILK ALLERGENS DETECTION IN SAMPLES OF COOKIES AND TEA BISCUITS**
Ksenija Marković, Zrinka Tišlarić, Ines Panjkota Krbavčić, Zvonimir Šatalić, Ivana Rumora Samarin, Nada Vahčić

P-05 **NEOFORMED COMPOUNDS FROM THE MAILLARD REACTION IN CEREAL COOKIES: EFFECT OF WHOLE-GRAIN FLOUR OF RYE, HULL-LESS OAT AND HULL-LESS BARLEY**
Slađana Žilić, Işıl Gürsul, Vural Gökmen, Dejan Dodig

CEREAL PROCESSING TECHNOLOGIES

P-06 **THE INFLUENCE OF THE PREPARATION METHOD ON THE QUALITY OF DONUTS**
Gordan Avdić, Dijana Miličević, Emina Nezić, Jasmina Hublić, Martina Tanović, Hurija Alibašić

P-07 **THE INNOVATIVE SOLUTIONS AND THE DEVELOPMENT OF A LOW-ENERGY AIR DRYER**
Sandra Budžaki, Jozo Leko, Krešimir Predrijevac, Tomislav Leko, Jožef Viszmeg, Kristina Jovanović

P-08 **ULTRASOUND SONICATION EFFECTS ON THE PASTING PROPERTIES OF BUCKWHEAT FLOUR**
Joanna Harasym, Urszula Kaim, Agnieszka Orkusz

P-09 **THE INFLUENCE OF THE ADDITION OF MODIFIED STARCHES AND HYDROCOLLOIDS ON THE PHENOLIC COMPOUNDS IN RED WINE CREAM FILLING**
Ivana Ivić, Mirela Kopjar, Matea Liška, Maja Marić, Anita Pichler

P-10 **THE INFLUENCE OF EXTRUSION PARAMETERS ON TOTAL PHENOLS AND FERULIC ACID OF WHEAT AND HULLESS BARLEY FLOUR**
Daniela Horvat, Marija Kovačević Babić, Gordana Šimić, Antun Jozinović, Alojzije Lalić, Georg Drezner, Jurislav Babić

P-11 **WHEY PROTEINS AS A VALUABLE INGREDIENT TO BAKERY PRODUCTS**
Bojan Matijević

P-12 **PRODUCTION OF THE ENRICHED CRACKERS PREPARED UNDER MINIMAL THERMAL TREATMENT**
Martina Tanović, Dijana Miličević, Gordan Avdić, Hurija Alibašić, Amela Jašić

P-13 **INFLUENCE OF THE TYPE OF SUGAR AND DIFFERENT TYPES OF FLOUR ON THE CHARACTERISTICS OF THE SHORTCRUST PASTRY**
Dijana Miličević, Gordan Avdić, Jasmina Hublić, Emina Nezić, Martina Tanović, Hurija Alibašić

P-14 **AN IMAGE PROCESSING APPROACH FOR COLOR-BASED SORTING AND COUNTING OF SELECTED CEREALS**
Silvija Šafranko, Ana-Marija Cikoš, Marija Banožić, Anamarija Stanković, Stela Jokić

CEREAL WASTE MANAGEMENT

P-15 **OPTIMIZATION OF ULTRASOUND-ASSISTED SOLID-LIQUID EXTRACTION FOR THE PHENOLIC ACIDS RECOVERY FROM BARLEY HUSK**
Gordana Šelo, Mirela Planinić, Marina Tišma, Josipa Grgić, Katarina Jukić, Ana Šušak, Srećko Tomas, Ivan Oršolić, Ana Bucić-Kojić

P-16 **HIGH-INTENSITY ULTRASOUND TREATMENT FOR THE INACTIVATION OF POLYPHENOL OXIDASE FROM WHEAT BRAN**
Matea Habuš, Ana Antolić, Gabrijela Šišić, Bojana Voučko, Nikolina Čukelj Mustač, Dubravka Novotni, Duška Ćurić

P-17 **PROPERTIES OF DIRECTLY EXPANDED CORN SNACK PRODUCTS ENRICHED WITH LYOPHILIZED TOMATO POMACE**
Antun Jozinović, Tanja Cvetković, Jasmina Ranilović, Irena Vađunec Bajrić, Nela Nedić Tiban, Đurđica Ačkar, Jurislav Babić, Drago Šubarić

P-18 **CHEMICAL CHARACTERISTICS OF COOKIES ENRICHED WITH EXTRUDED BREWER'S SPENT GRAIN**
Jovana Petrović, Biljana Pajin, Ivana Lončarević, Aleksandar Fišteš, Antun Jozinović, Đurđica Ačkar, Danica Zarić

P-19 **INFLUENCE OF HIGH INTENSITY ULTRASOUND ON PHYSICAL PROPERTIES AND BIOACTIVE COMPONENTS OF BUCKWHEAT HULLS**
Bojana Voučko, Dubravka Novotni, Andrea Buratović, Saša Drakula, Matea Habuš, Nikolina Čukelj Mustač, Duška Ćurić

CEREALS AND CEREAL PRODUCT QUALITY

P-20 **INFLUENCE OF THE HIGH-VOLTAGE ELECTRICAL DISCHARGE TREATMENT ON SELECTED PROPERTIES OF MAIZE STARCH**
Ivanka Grgić, Đurđica Ačkar, Marijana Grec, Jelena Panak Balentić, Antun Jozinović, Drago Šubarić, Nebojša Kojić, Jurislav Babić

P-21 **WHEAT BREAD WITH LACTO- FERMENTED SAVORY PLANTS**
Elena Bartkiene, Vita Lele, Paulina Zavistanaviciute, Vytaute Sakiene, Egle Zokaityte, Iveta Pugajeva, Vadims Bartkevics, Daiva Zadeike, Grazina Juodeikiene

P-22 **SENSORY PROPERTIES OF GLUTEN-FREE BREAD WITH PEA FLOUR AND IMPROVEMENT AGENTS**
Saša Drakula, Valentina Budimir, Marina Krpan, Dubravka Novotni, Bojana Voučko, Nikolina Čukelj Mustač, Mirjana Hruškar, Duška Ćurić

P-23 **THE EFFECT OF FREEZING CONDITIONS AND FROZEN STORAGE ON THE PHYSICAL AND SENSORY PROPERTIES OF PUFF PASTRY**
Anastasija Selaković, Olivera Šimurina, Dragana Šoronja-Simović, Jana Zahorec, Bojana Filipčev, Zita Šereš

P-24 **VOLATILE COMPOUNDS AND SHELF-LIFE OF LOW-SODIUM BREADS WITH ADDED AROMATIC PLANTS**
Emilija Friganović, Mladenka Šarolić, Boris Dorbić, Zvonimir Marijanović

P-25 **PROPERTIES OF STARCH ROASTED WITH APPLE DISTILLERY WASTEWATER**
Tomasz Zięba, Dominika Solińska, Małgorzata Kapelko-Żeberska, Artur Gryszkin, Đurđica Ačkar, Ante Lončarić, Jurislav Babić, Antun Jozinović

P-26 **THE CHANGES OF MINERAL COMPOSITION OF WHEAT AND CORN GRAINS OVER THE PAST CENTURY**
Zoltán Győri

P-27 **IMPACT OF CRICKET (*ACHETA DOMESTICUS*) FLOUR ADDITION ON THE VISCOMETRIC PROFILES OF FLOUR MIXTURES**
Joanna Harasym, Agnieszka Orkusz, Urszula Kaim

P-28 **WHEAT PROTEINS: QUANTITATIVE DISTRIBUTION UNDER NITROGEN FERTILISATION**
Daniela Horvat, Gordana Šimić, Krešimir Dvojković, Marko Ivić, Ivana Plavšin, Dario Novoselović

P-29 **POSITIVE EFFECTS OF BARLEY ON HUMAN HEALTH**
Nada Knežević, Mario Ivanuša, Marina Palfi

P-30 **CULTURAL-HISTORICAL HERITAGE OF THE KARLOVAC COUNTY – HOMEMADE BREAD AS A GASTRONOMIC TOURIST PRODUCT IN RESTAURANTS IN THE KARLOVAC COUNTY**
Draženka Birkić, Davorka Rujevčan, Elizabeta Kralj, Marijana Blažić

P-31 **THE OPTIMIZATION OF BISCUIT FORMULATION WITH GRAPE AND ARONIA POMACE AS COCOA SUBSTITUTES**
Dunja Molnar, Dubravka Novotni, Mario Ščetar, Tomislav Bosiljkov

P-32 **THERMOPHYSICAL PROPERTIES OF SOUR CHERRY FILLINGS**
Nela Nedić Tiban, Ana Živić, Mirela Kopjar

P-33 **HYDRATION PROPERTIES OF GLUTEN-FREE FLOUR MIXTURE MADE FROM RICE FLOUR AND CRICKET (*ACHETA DOMESTICUS*) FLOUR**
Agnieszka Orkusz, Urszula Kaim, Joanna Harasym

P-34 **CHARACTERISATION OF EDIBLE INSECT FLOUR USING INFRARED SPECTROSCOPY**
Agnieszka Orkusz, Wojciech Sąsiadek, Urszula Kaim, Joanna Harasym

P-35 **ROLLER MILLING OF TWO CROATIAN HULL-LESS BARLEYS AND THE CHARACTERISATION OF FRACTIONS OBTAINED BY THIS PROCESS**
Gordana Šimić, Daniela Horvat, Marija Kovačević Babić, Gjore Nakov, Marina Tišma, Ana Bucić-Kojić, Ana Šušak, Alojzije Lalić

P-36 **ENRICHMENT OF PASTA PRODUCTS WITH PLANT AND ANIMAL FATS**
Péter Sipos, Brigitta Horváth, Zoltán Győri

P-37 **SENSORY EVALUATION OF GLUTEN-FREE PSEUDOCEREAL BISCUITS**
Branka Varešić, Amela Semić, Amela Džafić, Sanja Oručević Žuljević

P-38 **DEVELOPMENT OF MATZO MADE OF WHOLEMEAL RYE FLOUR AND ITS IMPLEMENTATION IN THE INDUSTRY**
Antal Véha, Zita Boglárka Zakupszki, Balázs P. Szabó

P-39 **BREAD-MAKING PERFORMANCE OF COMMERCIAL DURUM WHEAT BY-PRODUCTS**
Abdenour Yesli, Samia Lefkir, Zakia Abdellaoui, Ghania Ounane

CEREALS AND CLIMATE CHANGES

P-40 **IMPACT OF HIGH TEMPERATURE ON THE ACCUMULATION OF PROLINE IN GENETICALLY DIVERGENT CEREAL VARIETIES**
Stefan Marković, Nevena Djukić, Aleksandra Torbica, Dragan Živančev, Simin Hagh Nazari

P-41 **PROTEIN AND PHENOLIC PROFILES OF WHEAT FLOUR AND THEIR RELATION TO THE RHEOLOGICAL BEHAVIOUR OF DOUGH**
Marijana Simić, Slađana Žilić, Dejan Dodig, Vuk Maksimović

CEREALS AND HEALTH

P-42 **FEATURES OF HEAVY METAL ACCUMULATION BY DIFFERENT VARIETIES OF BUCKWHEAT GROATS AND MILLET CEREALS**
Antonina Dubinina, Tetiana Popova, Svitlana Lenert, Inna Byelyayeva, Valeriia Hershun

P-43 **COMPARISON OF THE β-GLUCAN CONTENT IN DIFFERENT BARLEY GENOTYPES**
Nevena Djukić, Stefan Marković, Dragan Živančev, Aleksandra Torbica, Simin Hagh Nazari

P-44 **PROTEIN REMOVAL FROM OAT BETA-GLUCAN HIGH PURITY FRACTIONS**
Katarzyna Dziendzikowska, Ewa Żyła, Joanna Harasym, Joanna Gromadzka-Ostrowska

P-45 **BUCKWHEAT *(FAGOPYRUM ESCULENTUM* (MOENCH)), AMARANTH *(AMARANTHUS* SPP.) AND QUINOA *(CHENOPODIUM QUINOA* (WILD)) IN BAKERY PRODUCTS**
Szintia Jevcsák, Gerda Diósi, Péter Sipos

P-46 **EVALUATION OF THE EFFECTS OF VITAMIN AND MINERAL FORTIFIED BREAD ON SOME BLOOD PARAMETERS OF CHILDREN, ADULT AND OVERWEIGHT DIABETIC SUBJECTS**
Tülay Kahraman Genç

P-47 **IMPORTANT NUTRITIONAL INGEDIENTS OF GLUTEN-FREE BREAD WITH PSEUDOCEREALS**
Urszula Kaim, Joanna Harasym, Agnieszka Orkusz

P-48 **WHEAT AND GLUTEN RELATED DISORDERS**
Urszula Kaim, Joanna Harasym, Agnieszka Orkusz

P-49 **OCCUPATIONAL EXPOSURE OF FARMERS AND FOOD PROCESSING WORKERS TO FUNGI AND MYCOTOXINS**
Ante Lončarić, Tihomir Kovač, Biljana Crevar, Bojan Šarkanj

P-50 **MINERAL ELEMENTS IN WHEATGRASS JUICE**
Sanja Grubišić, Marija Kristić, Miroslav Lisjak, Sonja Petrović, Zdenko Lončarić, Andrijana Rebekić

P-51 **CEREAL PRODUCTS CONSUMPTION FREQUENCY IN RELATION TO ANTHROPOMETRIC AND BIOCHEMICAL PARAMETERS IN HOSPITALIZED SCHIZOPHRENIC PATIENTS**
Tamara Sorić, Mladen Mavar, Ivana Rumbak

P-52 **EFFECTS OF CEREAL CONSUMPTION ON GUT MICROBIOTA COMPOSITION**
Ivana Rumora Samarin, Ivona Grilec, Ana Samodol, Valentina Bačić, Ines Panjkota Krbavčić, Damir Oros, Antonio Starčević, Jurica Žučko

P-53 **POSSIBLE APPLICATIONS OF BREWER'S SPENT GRAIN IN PRODUCTION OF BREAD AND PASTRY**
Goran Saric

PLENARY LECTURES

(RE)CYCLING OF NANOMATERIALS-FROM THE LABORATORY TO THE TABLE AND BACK

Aleksandar Djordjevic*, Danica Jović, Ivana Borišev

University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg Dositeja Obradovića 3, 21000 Novi Sad, Serbia
*corresponding author: aleksandar.djordjevic@dh.uns.ac.rs

plenary lecture

Nanomaterials are classified as naturally occurring, accidentally synthesized, and engineered nanomaterials (ENMs). Whether engineered nanoparticles (ENPs) cause damage or benefits to the nature is an open question that has been asked for more than a decade. ENPs are nowadays being increasingly used in the most diverse products and human activities. In addition to the application of ENPs in medicine, pharmacy, electronics, and optics, the production of new materials also has a wide application in the food industry and agriculture. Nanotechnology is found in numerous sectors and products, some of which are agricultural products, nanofertilizers and biocides, farming of animals, food packaging, nanosupplements, food additives, and quality control. The most commonly used nanoparticles in food are based on SiO_2, Ag, Au, Fe, TiO_2, ZnO, carbon nanomaterials, and different polymers and nanocomposites. Nanoparticles can increase thermal stability while maintaining food freshness and enabling reheating in the original packaging. Nanoparticles can improve the barrier properties of gas gaps (O_2, CO_2) UV protection, humidity, and safe volatile compounds. Titanium dioxide-based nano-silver packaging was proved to have significant antifungal effects and it also increases the shelf-life storage of consumable bread. Nano-liposomal fish oil has placed itself as an effective additive for the improvement of the nutritional value of bread. Chitosan incorporated into bread mixtures could improve the lipoprotein balance. The determination of ENPs in food is a complex task and sets challenges for Chemists. The biggest challenge for science concerning nanomaterials is still the detailed examination of the effects of nanoparticles on biota and the environment in general.

Keywords: nanotechnology, nanomaterials, agronanotechnology, nano-packaging, food nanomaterials

WHEAT BREEDING CHALLENGES RELATED TO CLIMATE CHANGES

Krešimir Dvojković[1*], Dario Novoselović[1,2], Daniela Horvat[1], Marko Ivić[1], Ivana Plavšin[1,2], Georg Drezner[1]

[1]*Agricultural Institute Osijek, Južno Predgrađe 17, 31000 Osijek, Croatia*
[2]*Centre of Excellence for Biodiversity and Molecular Plant Breeding (CroP-BioDiv), Svetošimunska 25, 10000 Zagreb, Croatia*
[*]corresponding author: kresimir.dvojkovic@poljinos.hr

plenary lecture

Wheat (*Triticum aestivium* L.) is one of the most widely grown crops in the world, with the production of 772 million tonnes on 219 million hectares in 2017, providing on average 20% of the total calories in the human consumption. Estimated population growth of up to 9 billion people by 2050 clearly demands further increase in wheat production. Contrary to these needs, especially in the past few decades, we have all been witnessing increasingly frequent deviations in weather patterns, which threaten not only agricultural production but also many other aspects of modern life, and signal that the Earth's climate is changing. It seems inevitable that the next, in fact the already ongoing, long term challenge for humanity will be facing the progressive climate changes in order to ensure a sufficient food supply. The most direct solution to these challenges in the case of wheat will be to increase productivity through the adoption of cultivars with an improved genetic potential, as well as an improved response against diverse abiotic and biotic stressors. Wheat yield increase in the past 70 years has been manly driven by new improved cultivars coupled with enhanced agrotechnical measures (fertilizers, pesticides, soil tillage). Nowadays, even greater responsibility has been placed on breeders to create cultivars which will be able to deal with the rapidly changing environment. The implementation of an integrative and interdisciplinary breeding approach will be necessary to successfully address this issue on both the regional and the global level. An overview of the main breeding objectives, efforts, results, and prospects of the Agricultural Institute Osijek's wheat breeding programme regarding climate changes are going to be presented.

Keywords: wheat breeding, climate changes, cultivars

A NEW APPROACH IN EXTRUSION COOKING: CO_2 GAS INJECTION

Hamit Köksel[1*], M. Tugrul Masatcioglu[2]

[1]Hacettepe University, Food Engineering Department, Ankara, Turkey
[2]Hatay Mustafa Kemal University, Food Engineering Department, Hatay, Turkey
[*]corresponding author: koksel@hacettepe.edu.tr

plenary lecture

Extrusion cooking is a relatively new processing method used commonly in the production of snack foods, breakfast cereals, and ready-to-eat cereal products. It is a high temperature–short time process, which cooks, forms, and dries the product in one integrated operation. However, the conventional extrusion process may cause the loss of some of the functional nutrients, such as vitamins, antioxidants, and polyphenolics, because of the high processing temperatures and low moisture conditions used. Hence, it might promote the development of Maillard reaction products (MRPs), such as acrylamide, HMF, and furfural. A number of mitigation strategies, to reduce the content of MRPs in foods, have been proposed and tested. For instance, asparaginase application, prolonging yeast fermentation, and the replacement of ammonium bicarbonate with sodium bicarbonate as a leavening agent for bakery products can be used. Alternative mitigation strategies are still needed, due to the high cost and potential risks of the suggested methods. Recently, a new extrusion cooking technique involving the injection of carbon dioxide (CO_2) gas or supercritical CO_2 into the extruder barrel has started to be used in the production of novel and high-quality expanded cereal products. The major advantage of CO_2 injection in extrusion cooking is to prevent the effect of high temperature application on the heat-labile nutrients in foods. The aim of this presentation is to assess the advantages of CO_2 injection in the processing of cereals. Furthermore, the impact of CO_2 injection as a new alternative mitigation technology on process contaminants.

Keywords: extrusion cooking, CO_2 gas injection, Maillard reaction products, mitigation strategies

FOOD SAFETY IN THE CONTEXT OF CLIMATE CHANGE

Angelo Maggiore*, Jean Lou Dorne, Federica Barrucci, Giacomo De Sanctis, Raquel Garcia Matas, Yves van der Stede, Ana Afonso, Angeliki Konsta

European Food Safety Authority, Via Carlo Magno 1A, Parma, Italy
*corresponding author: angelo.maggiore@efsa.europa.eu

plenary lecture

While a broad range of forward-looking studies and publications examine the impact of climate change on food security, future challenges for food and feed safety, as well as nutrition quality, are often not specifically addressed. The CLEFSA project (Climate Change and Emerging Risks for Food Safety) aims at developing and testing new methodologies for emerging risks identification and producing a prioritised list of emerging issues/risks potentially affected by climate change. In particular, it explores the possibility of a) using a specific driver, climate change, for long term anticipation of emerging risks, b) using horizon scanning and crowdsourcing to collect a broad range of signals from a variety of information sources, c) designing Multi-Criteria Decision Analysis tools for prioritisation purposes. A transparent and reproducible five-step procedure has been designed. It consists of: definition of the identification criteria, identification of emerging issues, definition of prioritisation criteria, design of the ranking system, ranking of the identified issues. This procedure will also bring together past and present EFSA initiatives in the area of climate change, thus providing more transparency on how the EFSA is addressing this global issue. As an example, in 2012 the EFSA outsourced the development of a model to predict and map the emergence of aflatoxins in cereals in the EU due to climate change. Currently, an ongoing grant explores the development of a holistic, innovative, flexible risk assessment modelling approach for mycotoxin mixtures in food and feed. It is foreseen that integrated approaches will be applied to combine occurrence and hazard data and to assess the impact of climate change on mycotoxin production in raw commodities relevant to food and feed safety (e.g. rice, maize, etc..).

Keywords: emerging risks, food safety, climate change scenarios, mycotoxins, prioritisation, Multi-Criteria Decision Analysis (MCDA)

THE EFFECTS OF CLIMATE CHANGES ON MYCOTOXIN CONTAMINATION – FUTURE THREATS AND CHALLENGES

Jelka Pleadin*

Croatian Veterinary Institute, Laboratory for Analytical Chemistry,
Savska Cesta 143, 10000 Zagreb, Croatia
*corresponding author: pleadin@veinst.hr

plenary lecture

Mycotoxins represent secondary fungal metabolites capable of causing toxic effects in humans and animals. These substances can be found in a variety of important agricultural and food products, mainly in cereals and cereal-based products. Mycotoxin biosynthesis is affected by a simultaneous impact of several factors, which can increase the presence of toxicogenic moulds and mycotoxin production. The most important factor influencing mycotoxin contamination is climate, as proven during the last decades in many regions that are experiencing extreme weather conditions. Temperature and rainfall are most likely to be affected by future global changes, with a consequent wide impact on plants and their pathogens, mycotoxin occurrence included. Given that industrial processing yields no significant mycotoxin reduction, preventative measures taken to reduce such contamination to the minimum have been enacted and should be exercised by all means. In addition to the appropriate agricultural practices, cereals and cereal-based products should be properly stored and constantly controlled for mould growth. Given the high incidence of mycotoxins and possible adverse and synergistic effects in host organisms, it is necessary to identify mycotoxin-producing fungi and implement systematic monitoring of significant factors of influence, such as weather conditions, on an annual basis. Given the challenging nature of mycotoxin contamination prevention, further research is needed to better understand all the threats in the food production chain arising from climate changes.

Keywords: mycotoxins, climate changes, weather conditions, moulds, cereals

AGROMETEOROLOGICAL MODELING OF CEREAL YIELD IN FUTURE CLIMATE

Petra Sviličić[*], **Višnjica Vučetić**

Croatian Meteorological and Hydrological Service,Grič 3, 10000 Zagreb, Croatia
[*]corresponding author: svilicic@cirus.dhz.hr

plenary lecture

Agrometeorological modeling has expanded abruptly over the past twenty years and has been recognized as an important source of information for market stability and for reducing the socio-economic impact of crop loss. Due to the conservation of biodiversity, nowadays it is imperative not to extend further the agricultural land, but to accomplish the greatest possible potential that a particular crop can achieve per unit area while retaining its ability to adapt to climate change. The current challenge in agrometeorological modeling is to achieve satisfactory accuracy at the regional level with respect to the input values of the meteorological models. Detailed research on agrometeorological modeling in surrounding countries includes the use of the AquaCrop model. Their research includes the use of climate projections to determine yields of crops, most commonly maize. The results show that in the conditions of increased air temperature up to 2 °C there is a shortening of the vegetation period up to 25 days and a yield reduction of up to 33% in our region. According to the simulated values of the DSSAT model, in the period from 1949-2004 to the end of the 21st century in the Zagreb area, expected maize harvest is possible by up to one and a half month earlier with a 14-25% reduction in grain yield compared to the present climate conditions if today's maize hybrids and agrotechnical measures are sustained. For the time being, this is the only such research conducted in Croatia.

Keywords: agrometeorological modeling, climate change, yield reduction

CEREAL FOOD SAFETY

APPLICATION OF *LACTOBACILLI* IN COMBINATION WITH CRANBERRY COATING ON MOULD SPOILAGE PREVENTION AND ACRYLAMIDE REDUCTION IN WHEAT BREAD

Elena Bartkiene[1*], Vita Lele[1], Paulina Zavistanaviciute[1], Vytaute Sakiene[1], Vadims Bartkevics[2,3], Iveta Pugajeva[3], Daiva Zadeike[4], Grazina Juodeikiene[4]

[1]Lithuanian University of Health Sciences, Tilzes str. 18, LT-47181 Kaunas, Lithuania
[2]University of Latvia, Jelgavas iela 1, LV-1004 Riga, Latvia
[3]Institute of Food Safety, Animal Health and Environment, Lejupes iela 3, LV-1076 Riga, Latvia
[4]Kaunas University of Technology, Radvilenu str. 19, LT-50254 Kaunas, Lithuania
[*]corresponding author: elena.bartkiene@lsmuni.lt

oral presentation

Various lactic acid bacteria (LAB) strains (*Pediococcus pentosaceus*, *Pediococcus acidilactici*, *Lactobacillus paracasei*, *Lactobacillus brevis*, *Lactobacillus plantarum,* and *Leuconostoc mesenteroides*) in combination with cranberry (*Vaccinium oxycoccos* L.) coating were tested to increase bread quality and safety parameters, including moulding prevention and acrylamide reduction. The tested LAB showed the inhibition of *Penicillium funiculosum*, *Aspergillus nidulans*, and *Fusarium poae*. Antifungal activities of *L. brevis* and *Leu. mesenteroides* were low, but the above-mentioned LAB strains showed satisfying technological properties, as well as effective acrylamide (AA) reducing properties. The lowest AA concentration in bread prepared with 20% of *L. brevis* sourdough was 5.21 µg/kg. However, increasing the sourdough content decreases the quality parameters of bread (except *Leu. mesenteroides* sourdough). In addition, *Vaccinium oxycoccos* bread surface coating was tested. It was found that *Vaccinium oxycoccos* bread surface coating inhibited *P. funiculosum*, *A. fischeri*, *F. poae*, *Alternaria alternata*, *P. oxalicum,* and *F. graminearum* moulds. To sum up, the selected LAB strains in combination with the *Vaccinium oxycoccos* coating lead to higher quality and safety of the wheat bread, as well as extended shelf life.

Keywords: lactic acid bacteria, sourdough, fermentation, mould spoilage, acrylamide, extended shelf life

Acknowledgements:
The authors gratefully acknowledge the COST Action CA18101 "SOURDOugh biotechnology network towards novel, healthier and sustainable food and bIoproCesseS".

OCCURRENCE OF ACRYLAMIDE AND POLYCYCLIC AROMATIC HYDROCARBONS IN CEREAL BASED BABY FOOD

Tanja Bogdanović[1*], Sandra Petričević[1], Eddy Listeš[1], Darja Sokolić[2]

[1]Regional Veterinary Institute Split, Croatian Veterinary Institute, Poljička cesta 33, 21000 Split, Croatia
[2]Croatian Food Agency, Ivana Gundulića 36b, 31000 Osijek, Croatia
[*]corresponding author: t.bogdanovic.vzs@veinst.hr

oral presentation

The aim of this study was to determine the presence of chemical hazards in commercial baby food and to provide preventive recommendations to warrant product safety. Acrylamide and fifteen polycyclic aromatic hydrocarbons (PAHs) have been analysed in samples of ready-to-eat (jarred baby food, *n* = 9) instant baby food (*n* = 11) and biscuits and rusks (*n* = 15). The mean content of the acrylamide level was 53.9 ± 41.7 µg/kg in biscuits and rusks, 25.2 ± 10.1 µg/kg in instant baby food, and 33.8 ± 13.8 µg/kg in jarred baby food. None of the investigated foodstuffs exceeded the benchmark levels recommended by the EC 2017/2158 set at 40 µg/kg and 150 µg/kg (according to the composition), respectively. The total mean PAH content ranged from 2.27 µg/kg (in baby biscuits) to the maximum of 39.3 µg/kg (in jarred baby food - porridge of apples, pears, and bananas with wheat and oat flakes). The PAH profile was dominated by light PAHs, the percent-share of which spanned from 63.4% in baby biscuits to 97.8% in cereal gruels with fruit. All the concentrations of benzo(a)pyrene and ∑PAH4, including the maximum concentration, were within the EU maximum limit of 1 µg/kg. The contents of the analysed contaminants in baby food indicated no concern about the risk for infant health.

Keywords: acrylamide, cereal-based food, infant food, polycyclic aromatic hydrocarbons, processing contaminant

NEW RULES ON THE PROVISION OF INFORMATION ON THE COUNTRY OF ORIGIN OF THE PRIMARY INGREDIENT IN FOOD

Marija Batinić Sermek*, Sanja Kolarić Kravar, Jelena Đugum

Ministry of Agriculture, Ulica grada Vukovara, 78, 10000 Zagreb, Croatia
*corresponding author: marija.b-sermek@mps.hr

workshop lecture

Article 26 of the Regulation (EU) No 1169/2011 establishes general rules and requirements concerning the indication of the country of origin or the place of provenance of food. The indication of the country of origin or the place of provenance of food is mandatory in cases where the omission of this information could mislead the consumer as to the true country of origin or place of provenance of the food. Also, where the food business operator provides the country of origin or the place of provenance of food, and where this differs from the origin/provenance of the food's primary ingredient, the food business operator must provide either the country of origin or the place of provenance of the primary ingredient or an indication that the country of origin/place of provenance of the primary ingredient is different from the country of origin/place of provenance of the food. On 28 May 2018, the European Commission adopted the Implementing Regulation (EU) 2018/775 which clarifies how the origin of primary ingredients shall be labelled where the country of origin or the place of provenance of a food is given (by any means such as statements, pictorial presentation, symbols or terms, referring to places or geographical areas) and when the country of origin of the primary ingredient is different from the given origin of the food. The Implementing Regulation will apply from 1 April 2020. Food which is placed on the market or labelled prior to this date can be marketed until stocks are exhausted.

Keywords: food labelling, country of origin, primary ingredient

HOW CAN WE SAFELY HANDLE SURPLUS FOOD?

Andrea Gross-Bošković*

Croatian Agency for Agriculture and Food, Center for Food Safety,
Ivana Gundulića 36b, 31000 Osijek, Croatia
*corresponding author: andrea.gross-boskovic@hapih.hr

workshop lecture

Food safety is equally important for producers, suppliers, and consumers. In this respect, two different groups of microorganisms are relevant: Certain pathogens originating from food and microorganisms that are generally harmless to human health, but due to the fact that they are psychrophilic, they have the ability to multiply on the product during storage. The most commonly observed defect is the appearance of an unpleasant smell, while the shelf life of the product is determined by the initial number of microorganisms responsible for product defects and the temperature during the storage of the product at all stages of production and handling. This data is of utmost importance for determining the shelf life of food, which is important for all food chain participants, up to the final consumer.

Determining the shelf life of foods is based on food quality and food safety factors. It indicates the length of time the food should retain its properties before it begins to change or before the food becomes defective or starts to have reduced nutritional value.

When determining the durability of food, factors that must be taken into account are the microbiological burden of raw materials, the impact of the production process on product safety, the possibility of post-process contamination, and the growth limit of microorganisms during post-processing storage and distribution. Also, the significant factors affecting food degradation are the nature and quality of raw materials, product formulation, product structure, method of refrigeration and storage of products, type and condition of packaging, and transport/distribution conditions. For each of these factors, there are stipulated conditions that ensure product safety.

Keywords: food safety, shelf life of food, factors affecting food degradation

MYCOTOXINS: THE IMPACT ON HEALTH AND ANALYTICS

Slađana Rumpl Tunjić*

Labena d.o.o., Jaruščica 7, 10000 Zagreb, Croatia
*corresponding author: sladjana.rumpl-tunjic@labena.hr

sponsor advertisement presentation

The effects of mycotoxin on health and economic welfare became widely recognised after the plague of turkeys in the 60s, which was caused by aflatoxins. This event has prompted researchers to discover other mycotoxins and their impact on human health. Since then, many mycotoxins have been identified. Eating foods that have higher amounts of mycotoxins causes reduced appetite, nausea, vomiting, and diarrhoea. Chronic exposure to lower concentrations of certain mycotoxins can reduce the immune function, enhance cancer development, and cause embryo and hormonal disorders.

The content of mycotoxins in samples can be determined by accredited analytical methods (different types of chromatographs such as TLC, GLC, HPLC, MS). As analysis is done prior to purchase and before processing of the cereals into the finished product, most companies today use faster routine methods such as the immuno-enzyme (ELISA) and the immunochromatographic (LATERAL FLOW TECHNOLOGY) method. The practical advantage of the appropriate routine methods is in speed, simplicity, and low cost, with a simultaneous high reliability level.

Charm Sciences Inc. is the leading manufacturer of immunochromatographic tests and equipment for the rapid detection of mycotoxins in cereals. Predominantly using the technology of mycotoxin extraction with water, the reliability of these tests is confirmed by a number of approvals by the USDA GIPSA *. In a comparative study by the Belgian national reference laboratory for mycotoxins CODA-CERVA **, Charm tests for the determination of the DON mycotoxin achieved the best estimate of accuracy, repeatability, detection limits, and other criteria. The experience with regional samples from Slovenia and Croatia confirms the international results.

*United States Department of Agriculture; Grain Inspection, Packers & Stockyards Administration, Laws & Regulations;

**CODA-CERVA as the National Reference Laboratory (NRL) for mycotoxins; Veterinary and Agrochemical Research Centre, Operational Directorate of Chemical Safety of the Food Chain, Unit of Toxins and Natural Components, Belgium

Keyword: mycotoxin, health, analytical methods, immunochromatographic tests

THE EFFECIENCY OF MODERN MILL INDUSTRY CLEANING SYSTEMS ON MYCOTOXIN AND ALKALOID LEVELS IN CEREALS

Metka Ačko[1*], Lidija Tašner[2]

[1]Žito, d.o.o., Šmartinska cesta 154, 1000 Ljubljana, Slovenia
[2]Žito, d.o.o., Šmartinska cesta 154, 1000 Ljubljana, Slovenia
[*]corresponding author: metka.acko@zito.si

poster presentation

The article presents the entire process of purification of buckwheat, rye and wheat before milling with an emphasis on the removal of damaged, with mycotoxins contaminated grains, harmful seeds and their substances. The focus in modern cleaning process lies on the removal of fine and low-density impurities, removal of grain with low bulk density, optical sorting of discoloured, defective grain kernels, foreign seeds and sclerotia.

This year we modernized a cleaning system for cereals in the mill and validated the process. We have tested the effeciency of our new cleaning system for cereals infected by deoxynivalenol (DON), ochratoxin A (OTA), ergot alkaloids (EA) and tropane alkaloids (TA). The infected raw materials went through our whole cleaning system. The samples were taken according to regulations after each cleaning phase and at the end of the milling process. The concentration of DON was measured with Neogen rapid tests. OTA, TA and EA in buckwheat and rye were determined by the HPLC method in an accredited external laboratory.

Obtained data show that we can significantly reduce the alkaloid and mycotoxin levels and improve the health of the milling products with such a cleaning technology in our mill.

Keywords: mycotoxins, alkaloids, mill cleaning technology

EFFECT OF THE EXTRUSION PROCESS ON THE MYCOTOXIN CONTENT IN TRITICALE

Elizabet Janić Hajnal[1*], Janja Babič[2], Breda Jakovac Strajn[2], Jovana Kos[1], Vojislav Banjac[1], Radmilo Čolović[1], Katarina Pavšič Vrtač[2]

[1]Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
[2]Faculty of Veterinary medicine, University of Ljubljana, Gerbičeva 60, 1000 Ljubljana, Slovenia
[*]corresponding author: elizabet.janich@fins.uns.ac.rs

poster presentation

Cereals play an important role in daily human and animal diet. In addition to the nutritional value of cereals, the safety aspect is also extremely important. The most common chemical contaminants of cereal crops are mycotoxins – secondary metabolites produced by toxigenic filamentous fungi. In most cases, mycotoxins are stable under the usual process conditions during the production of cereal based products. Thus, the aim of this study was to investigate the effects of different extrusion process parameters. The moisture content (w = 20, 24 g/100 g), feeding rate (q= 20, 25 kg/h), and screw speed (v =3 00, 390, 480 rpm) impact on the rate of deoxynivalenol (DON), 15-acetyl-deoxynivalenol (15-AcDON), 3-acetyl-deoxynivalenol (3-AcDON), HT-2 toxin (HT-2), tenuazonic acid (TeA), tentoxin (TEN), and alternariol monomethyl ether (AME) in wholegrain triticale flour were examined by using a simple pilot single screw extruder. The highest reduction of the majority of the examined mycotoxins was achieved at high raw material moisture (w = 24 g/100 g), high feeding rate (q = 25 kg/h) and high screw speed (v = 480 rpm). Under these extrusion conditions, a reduction of 50.1%, 51.3%, 85.0%, 48.5%, 47.7%, and 43.7%, for DON, 3-AcDON, HT-2, TeA, TEN, and AME was achieved. The maximum reduction was achieved for 15-AcDON (64.5%), under the w = 20 g/100 g, q = 20 kg/h and v = 390 rpm.

Keywords: extrusion processing, wholegrain triticale flour, mycotoxins reduction, LC-MS/MS

Acknowledgments:
This research was funded by the Ministry of Education, Science and Technological Development, Republic of Serbia, as a part of the project Serbia – Slovenia joint project for the period 2018-2019 (BI-RS/18-19-007) and III 46001.

INFLUENCE OF IMMOBILIZED *LACTOBACILLI* IN APPLE POMACE FOR WHEAT - BARLEY BREAD PREPARATION

Elena Bartkiene[1], Vita Lele[1*], Donata Vizbickiene[1], Vadims Bartkevics[2], Iveta Pugajeva[2], Paulina Zavistanaviciute[1], Daiva Zadeike[3], Grazina Juodeikiene[3]

[1]Lithuanian University of Health Sciences, Tilzes str. 18, LT-47181 Kaunas, Lithuania
[2]University of Latvia, Centre of Food Chemistry Kr. Valdemara iela 48, LV-1013 Riga, Latvia
[3]Kaunas University of Technology, Radvilenu str. 19, LT-50254 Kaunas, Lithuania
[*]corresponding author: vita.lele@lsmuni.lt

poster presentation

In this experiment, the potential use of *Pediococcus acidilactici* immobilized in apple pomace and applied in barley sourdough fermentation for bread production was analysed. The strain was isolated, identified, and characterized by its resistance to acidic conditions, acidification rate, growth, and carbohydrate metabolism. The effect of the immobilized bacterial cells on the antioxidant properties of fermented barley and on the acrylamide (AA) content in wheat-barley bread was analysed. The phenotypic and molecular testing indicates that *P. acidilactici* has a universal acid resistance and carbohydrate metabolism, showing 42.7% of viable cells surviving after incubation at low pH, as compared with the initial number (7.5 $\log_{10}$ cfu/g). The fermentation with an immobilized *P. acidilactici* strain increased the production of lactic acid (LA) by 15.3% compared to spontaneous fermentation (24.2 g/kg), and the ability to produce *L*-lactic acid contents up to 92.7% from the total amount of LA. The use of *P. acidilactici* for barley flour fermentation increased β-glucan solubility by 1.3-5.1%, aside from that, the total phenolic compound (TPC) content and radical scavenging activity (DPPH) were found to be higher for up to 34.6% and 79.7%, respectively. The addition of fermented barley at a level of 10% could reduce the AA content in bread up to 44% and decelerate the bread staling process. The application of bacterial cells immobilized in apple pomace could have a future impact for the food industry due to its bioactive potential.

Keywords: *Pediococcus acidilactici*, apple pomace, bread, fermentation, acrylamide

Acknowledgements:
The authors gratefully acknowledge the COST Action CA18101 "SOURDOugh biotechnology network towards novel, healthier and sustainable food and bIoproCesseS".

MILK ALLERGENS DETECTION IN SAMPLES OF COOKIES AND TEA BISCUITS

Ksenija Marković, Zrinka Tišlarić, Ines Panjkota Krbavčić, Zvonimir Šatalić, Ivana Rumora Samarin*, Nada Vahčić

University of Zagreb, Faculty of Food Technology and Biotechnology, Department of Food Quality Control, Pierottieva 6, 10000 Zagreb, Croatia
*corresponding author: irumora@pbf.hr

poster presentation

Food allergies are becoming a significant public health issue. The presence of unintended allergens in food and unintentional exposure to allergens are the biggest problem for sensitive individuals. In this study, the ELISA (*Enzyme-Linked Immunosorbent Assay*) method was used for the detection of the presence of unintended milk allergens in total of seventeen cookies and tea biscuit samples from the Zagreb market. Twelve samples were taken from supermarkets, and five from the pastry shops. The obtained results were also compared with food information. Among seventeen analysed samples of cookies and tea biscuits, milk allergens were detected in twelve samples (average 0.58 mg/kg in samples from supermarkets, and 0.14 mg/kg in samples from a pastry shops). Three samples from supermarkets (two of which with the highest milk allergens content; 0.70 mg/kg) did not contain declared advisory label related to the presence of milk allergens. Food information about the presence of the milk allergens on the analysed samples of cookies and tea biscuits from pastry shops were not highlighted. The results of this study showed the importance of controlling the presence of unintended milk allergens in pre-packed and also in non pre-packed food, as well as the appropriate communication with the consumers facing nutritional allergy.

Keywords: allergens, ELISA, food information, milk, nutritional allergy

NEOFORMED COMPOUNDS FROM THE MAILLARD REACTION IN CEREAL COOKIES: EFFECT OF WHOLE-GRAIN FLOUR OF RYE, HULL-LESS OAT AND HULL-LESS BARLEY

Slađana Žilić[1*], Işıl Gürsul[2], Vural Gökmen[2], Dejan Dodig[3]

[1]Maize Research Institute, Department of Food Technology and Biochemistry, Slobodana Bajića 1, 11080 Zemun-Belgrade, Serbia
[2]Department of Food Engineering, Hacettepe University, 06800 Beytepe, Ankara, Turkey
[3]Maize Research Institute, Breeding Department, Slobodana Bajića 1, 11080 Zemun-Belgrade, Serbia
[*]corresponding author: szilic@mrizp.rs

poster presentation

This work aimed at studying the influence of whole-grain flour of rye, hull-less oat and hull-less barley and process conditions on the formation of undesirable Maillard compounds called neoformed contaminants (NFC) in cookies. Four NFCs were observed as furosine, carboxymethyllysine, carboxyethyllysine and acrylamide in cookies baked for 7, 10 and 13 min at 180 °C. Furosine is a marker of early Maillard reaction, while carboxymethyllysine, carboxyethyllysine and acrylamide are relatively stable advanced Maillard products with possible negative health effect. The results showed significant accumulation of all NFCs along baking with strong flour and baking time dependence. Acrylamide, carboxymethyllysine and carboxyethyllysine levels were increased as the load of the baking time was increased in cookies, while furosine concentration was rapidly increased to an apparent maximum after 7 min of baking followed by decreasing during longer time. Whole-grain flour of hull-less oat had the highest content of total lysine and free asparagine (10670.3 mg/kg and 859.8 mg/kg, respectively) and under the same baking conditions in cereal cookies it produced more furosine, carboxymethyllysine, carboxyethyllysine and acrylamide than whole-grain flour of rye and hull-less barley. In cookies prepared from oat, rye and barley flour and baked for 3 min, the content of acrylamide amounted to 861.7, 493.7 and 336.9 μg/kg, respectively. The use of flour originating from various cereals produce a clear effect on NFCs formation, therefore it is useful as a mitigation strategy in bakery products.

Keywords: whole-grain cereal flour, cereal cookies, acrylamide, furosine, N^{ε}-carboxymethyllysine and N^{ε}-carboxyethyllysine

CEREAL PROCESSING TECHNOLOGIES

RESISTANT STARCH – AN IDEAL FIBRE FOR THE CEREAL INDUSTRY

Đurđica Ačkar*, Antun Jozinović, Drago Šubarić, Borislav Miličević, Jurislav Babić

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
*corresponding author: dackar@ptfos.hr

invited lecture

Recently, a healthy diet is being increasingly promoted among the western population due to a high incidence of excessive weight and obesity among the adult and children populations. However, it is very hard to change habits, especially when food is involved. Therefore, any intervention in the nutritional value of popular calorie-dense products is desirable and beneficial.

In bakery products, adding fibre poses a technological and a sensorial challenge due to the influence on water binding during dough formation, problems with shaping, dough rising during baking, etc. All of these result in products with reduced quality attributes and consumers do not accept them as well as "original" products.

The solution may be sought in resistant starch – the portion of starch that escapes digestion in the small intestine and undergoes bacterial fermentation in the large intestine. EFSA reported that there is a cause and effect relationship between consumption of food rich in resistant starch and a reduction of post-prandial glycaemic responses. A large amount of research shows other beneficial health effects: treatment of chronic kidney disease, plasma lipids, satiety, and bodyweight.

Although physiologically resistant starch has the properties of a fibre, technologically it is the same as digestible starch – hence, the influence on product quality is minimal.

This presentation will give a short overview of novel research regarding the application of resistant starch in bakery and biscuit production.

Keywords: resistant starch, bakery product, biscuit, quality

UTILISATION OF EXTRUSION COOKING AND ENZYMATIC HYDROLYSIS TO INCREASE THE SOLUBLE FIBRE CONTENT OF WHEAT BRAN

Eda Aktas-Akyildiz[1,2*], M. Tugrul Masatcioglu[3], Hamit Köksel[1]

[1]Food Engineering Department, Hacettepe University, Ankara, Turkey
[2]Food Engineering Department, Hitit University, Çorum, Turkey
[3]Food Engineering Department, Hatay Mustafa Kemal University, Hatay, Turkey
[*]corresponding author: edaakts@gmail.com

oral presentation

The use of dietary fibres in food formulations such as bran is challenging, as they negatively affect the sensory properties and quality of food. Therefore, the need for high fibre food ingredients which have no deteriorative effects on quality has been increasing. Insoluble fibre is the major component responsible for the negative technological effects of wheat bran. Thus, increasing fibre solubility of wheat bran by processing is expected to improve its applications in food products. In the current study, the effect of the extrusion treatment on the microstructure and the enzymatic hydrolysis of wheat bran was investigated. A twin screw extruder was used to modify wheat bran at different feed moistures (12, 14, 16%), die-hole temperatures (105, 120, 135 °C) and screw speeds (100-200 rpm). Subsequent to extrusion, selected samples were hydrolysed with a commercial hydrolytic enzyme which had hemicellulase activity. The extrusion treatment increased fibre solubility after all the extrusion conditions. The most effective parameter for fibre solubilisation was found to be screw speed. The extrusion treatment affected the physicochemical properties of wheat bran. The water-binding capacities and water solubility of extruded bran samples were lower and higher than those of non-extruded wheat bran, respectively. The soluble DF content of enzyme treated bran samples increased and was found to be higher than those of respective samples at the beginning of incubation. In conclusion, an extrusion treatment can be used to disrupt the wheat bran microstructure and thus increase the soluble DF content. Moreover, to increase the solubility further, enzymatic hydrolysis can also be applied after extrusion. The outcomes of this study can be utilized for improving the technological functionality of cereal fibres, to develop high fibre ingredients for food applications.

Keywords: wheat bran, dietary fibre, extrusion, solubility, enzymatic hydrolysis

THE IMPORTANCE OF MARKETING IN THE PRODUCTION AND PROCESSING OF CEREALS IN INDUSTRY 4.0

Branimir Dukić[1*], Stojanka Dukić[2], Saša Mitrović[1]

[1]Faculty of Economics in Osijek, Gajev trg 7, 31000 Osijek, Croatia
[2]duxMissio d.o.o. Osijek, Dalmatinska 21, 31000 Osijek, Croatia
[*]corresponding author: bdukic@efos.hr

oral presentation

Prior to the advent of the digital era, in the 1970s, there were two major eras in the economic history of the world - the agricultural era and the industrial era. During the agricultural era and most of the industrial era, the production philosophy was the dominant philosophy in business. However, when supply began to outstrip demand, the focus shifted towards the selling concept. It proved ineffective in the long run, as it pushed products onto consumers whether they needed them or not, and was successfully replaced by the marketing concept in the mid-20th century. The essence of the marketing concept is the satisfaction of consumer needs. The marketing concept evolved as production potential and consumer awareness increased. Marketing evolution is primarily reflected in the degree of market segmentation. Mass marketing, which had been built around the idea of mass production, was replaced by segmented marketing, niche marketing, and finally by micro marketing. The growth of information and communication technologies enabled the development of industry 4.0 and the direct communication between the manufacturer and the consumer, in order to meet their individual needs, which led to the development of relationship marketing. A question arises as to whether a marketing concept and the concept of industry 4.0 can be applied in all areas of industrial production. To answer this question, this research focuses on analysing the importance of contemporary marketing and the potential of industry 4.0 in the production and processing of cereals.

Keywords: Digital Era, Marketing, Relationship Marketing, Production and Processing of Cereals, Industry 4.0

IMPORTANCE OF RHEOLOGICAL ANALYSIS IN WHEAT FLOUR DOUGH

Zeki Demirtasoglu[1*], Esra Zeynep Arslan[2]

[1]Bastak Instruments, Dagyaka mah, 2008 cad. No:12 Kahramankazan, Ankara, Turkey
[2]Bastak Instruments, Asagıeglence mah. Temizel Cad. No: 13/1 Etlik, Ankara, Turkey
[*]corresponding author: zeynep@bastak.com
sponsor advertisement presentation

Rheology can be defined as the examination of the properties of materials while a certain amount of force is being applied. Rheological analysis has become an important and preferable method of investigating the main properties and structure of wheat flour dough thanks to its sensitivity to changes in the structure of dough. Absograph and resistograph instruments can be used to understand the effects of the mixing period and the fermentation period during bread making. The general data collected from instruments includes water absorption capacity, stability, degree of softening, development time, elasticity, and the energy of dough. The quality of flour and which end-product to use can be determined according to these parameters. Also, they can be optimized according to the needs of the end-products by adding additives such as ascorbic acid, lipase, etc.

Keywords: wheat flour dough, rheology, rheological analysis, water absorption capacity energy

CREATION OF A MILLING PERFORMANCE INDEX (MPI) BASED ON THE BEHAVIOUR OF WHEAT DURING LABORATORY MILLING

Arnaud Dubat*

CHOPIN Technologies, 20 Avenue Marcelin Berthelot, 92390 Villeneuve la Garenne, France
*corresponding author: adubat@chopin.fr

sponsor advertisement presentation

A new laboratory mill was designed, the LabMill. Its diagram was studied to mimic the different actions that occur during industrial milling as close as possible. Although reducing the complexity of an industrial mill into a "2 Breaks, 1 sizing, 3 Reductions" diagram is a real challenge, and the results obtained from the mill are very promising. The talk will present data obtained while testing 150 wheat types collected across 14 countries worldwide and exhibiting very different behaviour. Product repartition within the diagram is greatly dependent of wheat performance during fractionation. These observations lead our research team to develop a simple way to describe these unique wheat characteristics. Our work led to the development of a 3 digit Milling Performance Index (MPi). The first digit represents the wheat resistance to crushing at first break, the second digit represents the easiness of a dissociation related to the capacity to produce fine middling instead of coarse middling, and the third digit represents the easiness of the reduction of the fine middling into flour. Data analysis showed that wheats with the same extraction can have very different MPi meaning that they will behave completely different during the process. On the contrary, wheat with the same MPi exhibit very similar and constant product repartition throughout the diagram.
Our first results obtained on 22 samples show that the LabMill gives a very good prediction of industrial Break flour (r^2 = 0.80), a good prediction of Sizing flour (r^2 = 0.66) and a very good prediction of Reduction flour (r^2 = 0.77).

Keywords: laboratory Milling, prediction, quality, behaviour during milling, wheat

TIM ZIP LTD

Tim Zip Ltd, Bani 100, 10000 Zagreb, Croatia
T. +385 1 660 80 30, F. +385 1 660 80 40
www.timzip.com
*corresponding author: timzip@timzip.hr

sponsor advertisement presentation

TIM ZIP is a private company founded in Zagreb in 1992 and specialized for bakery, pastry and confectionary technologies. The company is able to provide complete engineering on the highest level, from project design, prompt delivery and installation of equipment to new products development, staff trainings and service support.
TIM ZIP has sister companies in Serbia and Bosnia and Herzegovina.
TIM ZIP has more than 70 employees who speak seven European languages.
TIM ZIP's management successfully cooperates with more than 30 reputable suppliers of bakery equipment and with 10 suppliers of raw materials from 9 European countries.
Among the first, TIM ZIP adopted high European standards of ISO and HACCP.
TIM ZIP is the initiator of Richemont Club Croatia - association of bakery and pastry experts.
TIM ZIP is the organizer of Open Door Days, House Fair, TIM ZIP EXPO fair as well as expert seminars, artwork competition Golden Hands and Bread and Sweet Products Festival.
TIM ZIP is the publisher of 23 years old INFO magazine and five professional books in area of bakery and pastry.

TIM ZIP speaks by the KNOWLEDGE – more than 50% of its employees have university or college degree; it speaks by the EXPERIENCE – 27 years of leadership in developing, projecting and supplying of bakery business in the region and it speaks by the FACTS – more than 300 complete bakery projects and a list of more than 1000 satisfied, loyal customers from Croatia, Bosnia and Herzegovina, Montenegro, Macedonia, Slovenia and Serbia speak for themselves.

THE INFLUENCE OF THE PREPARATION METHOD ON THE QUALITY OF DONUTS

Gordan Avdić*, Dijana Miličević, Emina Nezić, Jasmina Hublić, Martina Tanović, Hurija Alibašić

Faculty of Technology, University in Tuzla, Univevrzitetska 8, 75000 Tuzla, Bosnia and Herzegovina
*corresponding author: gordan.avdic@untz.ba

poster presentation

The research topic is the production of donuts in four ways which differ according to the method of making dough, as well as according to raw material composition. The monitored data included the effect that the method of making dough had on the nutritional composition of donuts, the organoleptic characteristics, as well as the durability and quality of the final products.
The flour used in the process was TYPE 400, produced by the company "Mlin NEZIĆ" Gradačac. The acidity level, the amount of dry matter, the ash content, and the power to absorb water were determined. Donuts can be produced by directly mixing all raw materials together until a desired dough consistency is achieved. The second method is an indirect one, in which a pre-ferment is prepared with yeast and a part of flour and milk. After the fermentation, other raw materials are added and the dough is left again for fermentation. The third and fourth method consist of using ready-made donut mixtures (100% and 50%). The final products were analysed for the amount of dry matter, proteins and fat content, and the sensory evaluation of the final product was conducted as well.

Keywords: donuts, mixture, preparation method

THE INNOVATIVE SOLUTIONS AND THE DEVELOPMENT OF A LOW-ENERGY AIR DRYER

Sandra Budžaki[1*], Jozo Leko[2], Krešimir Predrijevac[2], Tomislav Leko[2], Jožef Viszmeg[2], Kristina Jovanović[2]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[2]CRAS d.o.o. Osijek, Vinkovačka cesta 68, 31 000 Osijek, Croatia
[*]corresponding author: sandra.budzaki@ptfos.hr

poster presentation

Drying is one of the most energy-intensive industrial processes, regardless of the processing material. In the industrial food production, drying can be used as the only step for food preservation and/or as a preparation stage in food processing. However, the quality of final dried product is a priority that need to be accomplished. This study will present the innovative solutions and development of a low-energy air dryer based on heat pump for application in food drying. The given solution, with a closed circulation of relatively low temperature air (up to 70 °C), proved to be very successful for production of high quality dried food.

Keywords: low-energy air dryer, energy efficiency, food

Acknowledgements:
The authors acknowledge financial support from the project KK.01.2.1.01.0031 financed by the European Regional Development Fund and Cohesion Fund.

ULTRASOUND SONICATION EFFECTS ON THE PASTING PROPERTIES OF BUCKWHEAT FLOUR

Joanna Harasym[1,2*], Urszula Kaim[1,2], Agnieszka Orkusz[1,2]

[1]*Adaptive Food Systems Accelerator – Science Centre, Wrocław University of Economics, Poland*
[2]*Department of Biotechnology and Food Analysis, Institute of Chemistry and Food Technology, Wrocław University of Economics, Poland*
[*]corresponding author: joanna.harasym@ue.wroc.pl

poster presentation

Buckwheat (*Fagopyrum esculentum* Moench) is a non-cereal plant classified as a pseudo-cereal due to a high achene containing a significant amount of starch. As a naturally gluten-free plant, it is perfect raw material for the formulation of gluten-free products, although its specific taste and aroma can hinder its widespread usage. Although the specific aroma, which is especially pronounced after thermal treatment, may restrict its application in food products, buckwheat flour can be used as a thickener in many semi-liquid products. However, high protein content, as well as other polysaccharides, present results in high viscosity of buckwheat flour gels.

The main objective of this study was the assessment of the pasting properties of buckwheat flours made from hulled buckwheat achenes subjected to ultrasound processing at 40 kHz in different solid:liquid ratios (1: 10, 1:5, 1:2.5).

The ultrasound treatment was observed to have a different impact depending on the solid:liquid ratio used. The 1:10 ratio seemed to have no strong impact on flour pasting properties, while the 1:5 ratio sample increased and the 1:2.5 ratio decreased peak viscosity. The final viscosity was the lowest in the sample with the 1:2.5 solid:liquid ratio. The breakdown and setback viscosity were similar for 1:10 and 1:2.5 samples, while the 1:5 ratio samples were highest and lowest, respectively. The pasting curves seemed to be flattened, indicating more stable *vs.* temperature changes behaviour.

Keywords: buckwheat flour, ultrasound treatment, pasting properties

THE INFLUENCE OF THE ADDITION OF MODIFIED STARCHES AND HYDROCOLLOIDS ON THE PHENOLIC COMPOUNDS IN RED WINE CREAM FILLING

Ivana Ivić*, Mirela Kopjar, Matea Liška, Maja Marić, Anita Pichler

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
*corresponding author: iivic@ptfos.hr

poster presentation

Although wine is primarily used as a drink, it is also often used as a supplement during cooking, mostly to enhance the flavour of various sauces. In addition to the flavour, the texture, thickness, and colour of such prepared dishes are of great importance for consumers. To achieve the desired thickness, different thickening agents can be added, like modified starches (isolated from waxy maize, tapioca, or potato) and hydrocolloids (guar gum, cellulose, xanthan gum). In this study, modified starches (5%) and hydrocolloids (1%) were added to red wine (Cabernet Sauvignon) and after ten minutes of cooking at 85 °C, red wine cream filling was obtained. The aim was to determine the influence of the addition of thickening agents on the retention of phenolic compounds in the samples mentioned above. The concentrations of total polyphenols and anthocyanins, as well as polymeric colour and antioxidant activity were determined spectrophotometrically, and the results were compared to untreated wine and wine cooked without thickening agents. The results have shown that the samples cooked with hydrocolloids cellulose and xanthan gum had the highest retention of phenolic compounds, followed by the samples cooked with tapioca and waxy maize modified starch. The lowest concentrations of phenolic compounds were found in the samples cooked with hydrocolloids guar gum and with potato modified starch (with the exception of anthocyanin retention, where the sample with potato modified starch had the second highest concentration).

Keywords: red wine, modified starch, hydrocolloid, phenolic compounds

THE INFLUENCE OF EXTRUSION PARAMETERS ON TOTAL PHENOLS AND FERULIC ACID OF WHEAT AND HULLESS BARLEY FLOUR

Daniela Horvat[1], Marija Kovačević Babić[1*], Gordana Šimić[1], Antun Jozinović[2], Alojzije Lalić[1], Georg Drezner[1], Jurislav Babić[2]

[1]Agricultural Institute Osijek, Južno predgrađe 17, 31000 Osijek, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[*]corresponding author: marija.kovacevic.babic@poljinos.hr

poster presentation

Ferulic acid is the most abundant phenolic acid in cereals (70-90% of total phenolic compounds). The outer layers of grain have been shown to contain much higher levels of ferulic acid than endosperm. The aim of this study was to determine the effect of the extrusion process with different temperature in the die section (90, 100 and 110 °C), and the moisture content (25, 30 and 35%) on total phenols and ferulic acid on wheat and hulless barley flours using spectrophotometric and HPLC methods. The non-extruded wheat flour contains significantly less ferulic acid (27.11 μg/g_{DW}) than hulless barley flour (56.21 μg/g_{DW}), while the total phenolic content was more similar in both flours (752 and 779 μg GAE/g_{DW}, respectively). In extruded wheat flours a slight decrease of ferulic acid was noticed compared to the non-extruded flour. On the other hand, in hulless barley flours ferulic acid content was significantly increased after the extrusion process. The extrusion had a negative effect on the total phenolic content and this negative effect was the lowest in the extruded samples with the moisture content of 25%, both of wheat and barley flours (426 and 449 μg GAE/g_{DW}, respectively).

Keywords: extrusion, wheat, hulless barley, total phenols, ferulic acid

WHEY PROTEINS AS A VALUABLE INGREDIENT TO BAKERY PRODUCTS

Bojan Matijević*

Karlovac University of Applied Sciences, Trg J.J.Strossmayera 9, 47000 Karlovac, Croatia
*corresponding author: bojan.matijevic@vuka.hr

poster presentation

Whey proteins represent 18 - 20% of total milk nitrogen content. They can be used as ingredient to various food products due to their unique functional characteristics, such as emulsifying, gelation, thickening, foaming and water binding ability. Besides their desirable functional characteristics, they also have high nutritional value. Biological value, as well as other nutritional value indicators could be attributed to favorable amino acid composition, mostly to the presence of valuable α-lactalbumin whose amino acid composition is close to the biological optimum. Whey proteins, as ingredient on the market, can be obtain in several different form, most commonly as whey protein isolate (WPI) and whey protein concentrate (WPC). Whey proteins can been considered as a potential ingredient for the bakery industry in view of their desirable functional characteristics and nutritive value. When used in baking, whey ingredients can emulsify, thicken, brown, and foam products. Whey powder also increases solubility, gelation, water binding and nutritional fortification. However, the effect depends on the type and level of whey protein concentrate (WPC). WPC is best for egg replacement in baked goods, but can help in replacement of gluten levels, because its structure and gas-trapping properties mimic gluten. In addition, WPC might be used to reduce fat and carbohydrates, while increasing the nutritional benefits of the product. This paper present effect of whey proteins on the physicochemical, textural and nutritional properties of bakery products.

Keywords: bakery products, ingredient, whey proteins

PRODUCTION OF THE ENRICHED CRACKERS PREPARED UNDER MINIMAL THERMAL TREATMENT

Martina Tanović, Dijana Miličević*, Gordan Avdić, Hurija Alibašić, Amela Jašić

Faculty of Technology, University in Tuzla, Univevrzitetska 8, 75000 Tuzla, Bosnia and Herzegovina
*coresponding author: dijana.milicevic@untz.ba

poster presentation

Crackers are products made with flour and other ingredients. They can be salty or sweet and are classified into a biscuit and snack product group. They are mainly produced from white wheat flour, salt and sugar, and other additives, whose amount depends on whether they are salty, sweet or stuffed. Today, people demand foods that are not too processed and that are convenient for use, yet rich in all substances needed for maintenance of the body and rapid energy recovery. Therefore, crackers are produced with slightly modified ingredients, with reduced quantities of flour and sugar or without their addition. Instead, raw materials rich in proteins, natural sugar and fats are used, which do not have detrimental effects on the human body. In this research, protein-rich and energy-high crackers have been produced, because they contain a higher amount of fat, proteins and sugar. However, fats and sugars were not added but come from specific ingredients (hazelnuts, walnuts, chia seeds, sesame, sunflower and pumpkin seeds, oat flakes, etc.). Four cracker formulations were developed, two with hazelnuts and two with walnuts, added in the amount of 25% and 50%, respectively. The other ingredients were added in the same amount. The product was dried at 80 °C for several hours. The proximate composition, polyphenolic compounds and antioxidant capacity were determined in the products before and after drying.

Keywords: cracker, hazelnut, walnut, oat flakes, drying

INFLUENCE OF THE TYPE OF SUGAR AND DIFFERENT TYPES OF FLOUR ON THE CHARACTERISTICS OF THE SHORTCRUST PASTRY

Dijana Miličević*, Gordan Avdić, Jasmina Hublić, Emina Nezić, Martina Tanović, Hurija Alibašić

Faculty of Technology, University in Tuzla, Univevrzitetska 8, 75000 Tuzla, Bosnia and Herzegovina
*corresponding author: dijana.milicevic@untz.ba

poster presentation

The goal of this research was the production of shortcrust pastry and products from that pastry using different types of sugar and various types of wheat flour and the addition of wheat starch. As basic raw materials, flour and sugar should influence the making of the pastry, the baking and the quality of the finished products. Finished products will be sensory analyzed.
The level of acidity, ash content, water absorption and dry matter content were determined in the flour. Sugar solubility test was done. Shortcrust pastry was prepared according to the 1 – 2 – 3 recipe, where different types of flour (T-400, T-550, combination of the flour T-550 and wheat starch in 50:50 ratio) and sugar (crystal, powdered sugar) were used. The products were made from different types of shortcrust pastry. Finished products were sensory analyzed 1 and 24 hours after baking. Freshness of the finished products was observed. Dry matter content was determined in the finished products immediately, then after 24, 48 and 72 hours.

Keywords: shortcrust pastry, flour, sugar, shortcrust cookies

AN IMAGE PROCESSING APPROACH FOR COLOR-BASED SORTING AND COUNTING OF SELECTED CEREALS

Silvija Šafranko[1*], Ana-Marija Cikoš[1], Marija Banožić[1], Anamarija Stanković[2], Stela Jokić[1]

[1]Faculty of Food Technology Osijek, Josip Juraj Strossmayer University of Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[2]Department of Chemistry, University of Osijek, Ulica cara Hadrijana 8/A, 31000 Osijek, Croatia
[*]corresponding author: silvija.safranko@ptfos.hr

poster presentation

Physical characteristics of cereals, such as grain size, bulk density, length, shape, or color, are of a great importance in terms of product control and quality. Grain counting and sorting is considered as an essential step in product quality assessment, classification, and cultivation management in general. However, that procedure is usually carried out manually, which can be time-consuming and inconvenient, or by instruments which are rather expensive and bulky. An alternative and non-destructive method for cereal quality evaluation is based on an image processing approach widely used in food industry and agriculture.
In this study, an image processing method has been developed and modified for cereal grain counting and sorting; it is based on a color segmentation algorithm which allows the division of an image into specific regions. The total number of objects in the image can be detected or those objects can be classified and counted based on different colors, in this case, using RGB to CIELab color space conversion. The developed method has been tested and evaluated on maize, wheat, buckwheat, and rice, by varying the number and type of cereal grains for each testing sample. The obtained results showed good efficiency and accuracy of the developed image processing method which could be a useful counting and sorting tool with a wide range of applications.

Keywords: cereals, image processing, color, sorting, counting

CEREAL WASTE MANAGEMENT

POTENTIAL PRODUCTION OF NUTRITIONALLY ENRICHED COOKIES USING FOOD INDUSTRY BY-PRODUCTS

Biljana Pajin*

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
*corresponding author: pajinb@tf.uns.ac.rs

invited lecture

The use of by-products is a growing trend in the food industry. Motives for the use of by-products are the increase in the nutritional value of new products, better valorisation of these by-products, and the reduction of total waste. Brewers spent grain (BSG) is the main by-product in the beer industry. It is a lignocellulosic material with about 17% cellulose, 28% non-cellulose polysaccharides, and 28% lignin. BSG contains proteins of high biological value rich in glutamine, and minerals and vitamins are also present. Considering the large share of dietary fibre (70%), protein (20%), and β-glucan, BSG has great potential for nutritional enrichment of various food products. Sugar beet pulp, with molasses, is the most important by-product of sugar beet processing. This nutritional value by-product contains 20-25% of cellulose, 25-36% of hemicellulose, 20-25% of pectin, 1-2% of lignin, and 10-15% of proteins. Apple pomace is the main by-product that lags after the production of juice. Polyphenols and terpenoids that have a positive effect on the human organism (anti-inflammatory, antimicrobial, and antioxidant) are present in apple pomace. This by-product contains large quantities of pectin (13-39%) and dietary fibre (50% of total dietary fibre, of which about 35% are insoluble and 15% are soluble fibres). Defatted wheat germ contains more than 30% of proteins. It is rich in essential amino acids lysine, methionine, and threonine that are otherwise deficient in cereals. Accordingly, the addition of wheat germ is primarily accompanied by an increase in the protein value of finished products. Wheat germ is also an excellent source of phosphorus, manganese, iron, copper, magnesium, selenium, and zinc, as well as B vitamins and tocopherols. Due to the differences in their chemical composition, different by-products will have different influence on the cookie dough and the final product. The aim of this research was to investigate all those influences and to optimize the type and quantity (5, 10, or 15%) of by-products that will lead to cookies with the best nutritional and sensory characteristics.

Keywords: food by-product valorisation, cookies, nutritionally enriched product

NATIONAL FOOD WASTE PREVENTION STRATEGY AND NEW TOOLS IN FOOD REDISTRIBUTION

Iva Skelin Paulić*

Ministry of Agriculture, Directorate for Livestock and Food Quality, Food Quality Sector, Food Quality and Food information Service, Food Waste Prevention Department, Ul. grada Vukovara 78, 10000 Zagreb, Croatia
*corresponding author: iva.skelin@mps.hr

workshop lecture

According to the Food and Agriculture Organization, one third of the world's annual food production is wasted. In the EU, around 88 million tonnes of food is wasted annually. As a contribution for the achievement of the 2030 Agenda for Sustainable Development, especially its 12.3 target, Croatia has drafted a Food Waste Reduction and Prevention Plan 2019-2022. Measures and activities like encouraging the reduction of food waste at all levels of the food chain, promoting social responsibility, raising consumer awareness regarding the prevention and reduction of food waste, conducting campaigns related to understanding the link between food labelling and food waste, education of children, improving food waste measurement, and investing in research and innovative solutions will contribute to the reduction of food waste. The basis for drafting the measure regarding the improvement of the food donation system was provided by the Research on the Food Donation System in Croatia, which was conducted in cooperation with the Faculty of Food Technology and Biotechnology in 2017. Improving the food donation system will be achieved by improving the legislative framework, as well as education and guidelines, enhancing communication between donors and food redistribution organizations through new tools like e-donation, establishing the Food Bank on the basis of the Feasibility Study, promoting the EU funds, and conducting campaigns by raising the awareness of all stakeholders. In order to have a successful food donation system, it is important to know who are the stakeholders, what requirements food redistribution organizations have to fulfil, which food can be donated, under what conditions, and what are the benefits of donations.

Keywords: food waste, Food Waste Reduction and Prevention Plan, food donation, food bank

OPTIMIZATION OF ULTRASOUND-ASSISTED SOLID-LIQUID EXTRACTION FOR THE PHENOLIC ACIDS RECOVERY FROM BARLEY HUSK

Gordana Šelo[1], Mirela Planinić[1], Marina Tišma[1], Josipa Grgić[1], Katarina Jukić[2], Ana Šušak[1], Srećko Tomas[1], Ivan Oršolić[1], Ana Bucić-Kojić[1*]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[2]Bc Institute for Breeding and Production of Field Crops, Rugvica, Dugoselska 7, 10370 Dugo Selo, Croatia
[*]corresponding author: abucic@ptfos.hr

poster presentation

The ultrasound-assisted solid-liquid extraction of phenolic acids from barley husk was optimized using response surface methodology (RSM). A Box-Behnken design was used to investigate the effects of extraction temperature (40-80 °C), solvent concentration (ethanol/water 50-90%, *v*/*v*), time (10-30 min) and ultrasonic power (40-80%), as well as their interaction on the extractability of phenolic acids (3,4-dihydroxybenzoic, *p*-hydroxybenzoic acid, *p*-hydroxyphenylacetic, vanillic, caffeic, syringic, *p*-coumaric, ferulic, ellagic, *o*-coumaric acids).
Barley husk obtained from winter barley variety "Favorit" (Bc Institute d.d. Zagreb, Croatia) was used. The extraction was performed using the ultrasonic bath at sweep mode and ultrasonic frequency of 37 kHz. Individual phenolic acids from barley husk extracts were quantified by UHPLC and the sum of their content was employed in the optimization procedure.
RSM analysis showed that solvent concentration had a significant effect on phenolic acids recovery, while the effects of other factors and their interactions were not significant.
The optimal extraction conditions were found to be 80 °C, 50%, *v*/*v* ethanol/water, 40% ultrasonic power and 10 min. At these conditions, the predicted value of phenolic acids yield was 134 $\mu g/g_{db}$.

Keywords: ultrasound-assisted extraction, phenolic acids, barley husk, response surface methodology

Acknowledgement:
This work was supported by the Croatian Science Foundation under the project (IP-2018-01-1227) "Development of a sustainable integrated process for the production of bioactive isolates from food industry residues" (POPI-WinCEco).

HIGH-INTENSITY ULTRASOUND TREATMENT FOR THE INACTIVATION OF POLYPHENOL OXIDASE FROM WHEAT BRAN

Matea Habuš, Ana Antolić, Gabrijela Šišić, Bojana Voučko, Nikolina Čukelj Mustač, Dubravka Novotni*, Duška Ćurić

Faculty of Food Technology and Biotechnology, University of Zagreb Pierottijeva 6, 10000 Zagreb, Croatia
*corresponding author: dnovotni2@pbf.hr

poster presentation

Wheat bran, a by-product of industrial wheat grain milling, is a rich source of dietary fibre and bioactive compounds beneficial for human health. At the same time, dominant phenolic acids, including ferulic and *p*-coumaric acid, are potential substrates for the enzyme polyphenol oxidase (PPO), which is also present in wheat bran. PPO generates undesirable browning of wheat-based products. The aim of this study was to investigate the effect of high-intensity ultrasound (400 W) treatment on the content of PPO, total phenolic compounds (TPC), antioxidant activity, and colour of wheat bran. The experiment was run dependant on bran particle size (10-510 μm), ultrasound amplitude (60-100%), and the treatment duration (5-15 min), according to the central composite design. TPC (with the Folin-Ciocalteu Method), antioxidant activity (with FRAP and DPPH methods), PPO activity (AACC International Method 22-85), and the colour of samples were determined spectrophotometrically. The ultrasound treatment significantly reduced the PPO activity from 2.0 to 0.1 A_{475nm}, depending on the interaction of particle size, ultrasound amplitude, and treatment duration (p<0.05). Generally, the lower particle size and longer ultrasound treatment caused more severe PPO inactivation. The colour of all treated samples was lighter compared to the control untreated bran. At the same time, TPC and antioxidant activity were decreased or increased depending on the treatment. In optimized conditions, the ultrasound treatment (80% amplitude for 10 min) successfully inactivates the PPO of wheat bran, with minimum degradation of targeted bioactive compounds and without the use of chemicals.

Keywords: high-intensity ultrasound, wheat bran, polyphenols, polyphenol oxidase

PROPERTIES OF DIRECTLY EXPANDED CORN SNACK PRODUCTS ENRICHED WITH LYOPHILIZED TOMATO POMACE

Antun Jozinović[1*], Tanja Cvetković[2], Jasmina Ranilović[2], Irena Vađunec Bajrić[2], Nela Nedić Tiban[1], Đurđica Ačkar[1], Jurislav Babić[1], Drago Šubarić[1]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[2]Podravka d.d., Research and Development, Ante Starčevića 32, 48000 Koprivnica, Croatia
[*]corresponding author: ajozinovic@ptfos.hr

poster presentation

Tomato pomace, as a by-product of tomato processing, is mainly composed of dietary fibre, which represents up to 50% d.m. of this by-product. In addition, it is a good source of high-value ingredients such as lycopene, which is an excellent natural pigment that gives the specific colour to the food and also serves as a functional ingredient with important health benefits. Therefore, the aim of this study was to investigate the potential application of tomato pomace left over as a by-product from the tomato processing industry.

The study included lyophilisation of tomato pomace and its application in the production of corn-based directly expanded products. Corn grits and lyophilized tomato pomace were mixed at different ratios (100:0; 97:3, 94:6, 91:9, and 88:12). The prepared samples with the 15% moisture content were extruded in a laboratory single screw extruder at the temperature profile of 135/170/170 °C, using a screw with the compression ratio of 4:1 and a die with a 4 mm diameter. The obtained extrudates were dried in a laboratory oven at 50 °C for 2 h, and the physical properties of the extrudates were determined.

It could be concluded from the obtained results that the addition of lyophilized tomato pomace to corn grits caused the reduction of the expansion ratio and the fracturability of extrudates. In the samples with added tomato pomace, bulk density decreased in comparison to the control sample of extruded corn grits, with the most significant effect at the ratio of 97:3. The hardness of extrudates decreased with the addition of tomato pomace, with the most significant effect at the ratio of 94:6. The extrusion process and the addition of tomato pomace influenced the change in colour, whereby the total colour change is more pronounced for the samples with a higher amount of tomato pomace.

Keywords: corn snack products, tomato pomace, lyophilisation, physical properties

CHEMICAL CHARACTERISTICS OF COOKIES ENRICHED WITH EXTRUDED BREWER'S SPENT GRAIN

Jovana Petrović[1*], Biljana Pajin[1], Ivana Lončarević[1], Aleksandar Fišteš[1], Antun Jozinović[2], Đurđica Ačkar[2], Danica Zarić[3]

[1]Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[3]Ihis Techno Experts d.o.o., Research development center, 11000 Belgrade, Serbia
[*]corresponding author: jovana@tf.uns.ac.rs

poster presentation

Nowadays, most brewer's companies are trying to recycle their residues. Brewer's spent grain (BSG) is produced in quantities of 20 kg per 100 L of beer. This residue can be valuable raw material for other processes. It is low or no cost potential raw material available throughout the year. Brewer's spent grain is lignocellulosic material, rich in dietary fibre and proteins, and has potential to increase nutritional value of cookies. The aim of this paper is to explore the influence of the extruded brewer's spent grain (EBSG) on cookies nutritional profile. Because of its high moisture content, BSG is a highly unstable material subjected to microbial activity. BSG was mixed with corn grits at ratios 15:85, 30:75 and 45:55 and extruded in the laboratory single screw extruder to prolong storage time and preserve BSG quality. After drying and milling, EBSG was used to replace wheat flour during preparation of cookies in the amount of 5, 10 and 15%. The addition of EBSG significantly increased the proportion of fibre (from 2.06 to 7.07%), protein (from 5.49 to 7.64%) and ash (from 0.48 to 0.89%) in the cookies. It can be concluded that the EBSG can be successfully incorporated in cookies in the amount up to 15% with the aim of producing nutritionally more valuable product.

Keywords: brewer's spent grain, by-product, chemical characteristics, cookies

Acknowledgment:
The authors highly appreciate financial support of the Provincial Secretariat for High Education and Scientific Research of the Government of Autonomous Province of Vojvodina, Republic of Serbia, project: Valorization of by-products of the food industry through the development of nutritionally enriched cookies and crackers.

INFLUENCE OF HIGH INTENSITY ULTRASOUND ON PHYSICAL PROPERTIES AND BIOACTIVE COMPONENTS OF BUCKWHEAT HULLS

Bojana Voučko, Dubravka Novotni*, Andrea Buratović, Saša Drakula, Matea Habuš, Nikolina Čukelj Mustač, Duška Ćurić

University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, 10000 Zagreb, Croatia
*corresponding author: dnovotni2@pbf.hr

poster presentation

Buckwheat is a pseudocereal with growing popularity in the food industry due to its pleasing nutritive and sensory properties. Buckwheat hulls are a milling by-product with high antioxidant activity, consisting mainly of dietary fibre (91%). The aim of this study was to optimize high intensity ultrasound (HIU) treatment conditions of buckwheat hulls, to obtain buckwheat hulls with an enhanced share of free total phenolics, flavonoid rutin, antioxidant activity, increased polyphenol oxidase activity, and water swelling capacity. Increased water swelling indicates improved capacity for the reduction of blood cholesterol while polyphenol oxidise catalyses protein crosslinking and could therefore be beneficiary to the formation of the protein network in gluten-free bakery products and fibre enriched bakery products in general. Thirteen HIU treatments of 15% water suspensions of buckwheat hulls were done according to a central composite design, using a 400 W processor at the amplitude of 100% and a 22 mm probe, by varying treatment times (5, 10, or 15 min) and initial sample temperatures (at 20, 45, or 70 °C), with 5 replications of the central point. Compared to the untreated sample, the best HIU treatment was the one lasting 15 minutes with the initial sample temperature of 20 °C. It caused a significant increase in the water swelling capacity (93%) and the enhancement of polyphenol oxidase activity (114%) and antioxidant capacity (DPPH test 47%, FRAP test 26%) of buckwheat hulls. Amounts of total phenolics (180 GAE mg/100 g d.w.) and rutin (26 mg/100 g d.w.) were similar to the ones found in whole buckwheat flour, but remained unchanged after the HIU.

Keywords: buckwheat hulls, by-product, high intensity ultrasound, water swelling, antioxidants

CEREALS AND CEREAL PRODUCT QUALITY

QUALITY OF MERCANTILE WHEAT VARIETIES IN THE REPUBLIC OF CROATIA ACCORDING TO THE CODEX FOR THE PURCHASE OF CEREALS AND OILSEEDS

Goran Jukić[1*], Ivana Rukavina[2], Krunoslav Dugalić[2], Ivan Varnica[1], Krešimir Šunjić[1]

[1]Croatian Agency for Agriculture and Food, Center for Seeds and Seedlings, Usorska 19, Brijest, 31000 Osijek, Croatia
[2]Croatian Agency for Agriculture and Food, General Manager's Office, Vinkovačka cesta 63, 31000 Osijek, Croatia
[*]corresponding author: goran.jukic@hapih.hr

invited lecture

Since 2015 in the Republic of Croatia the purchase of mercantile wheat has begun to be applied in accordance with the Codex for the purchase of cereals and oilseeds. The consequence of this action was the replacement of the varieties in the assortment (variety Srpanjaka with 15.43% presence in 2015) with a new high yield and higher protein content varieties (variety Kraljica with 26.83% presence in 2018). The field trial was set up in two repetitions at the HAPIH - Center for Seed and Seedlings, location Osijek with standard agro-technical measurements during the four vegetation years: 2014/2015, 2015/2016, 2016/2017 and 2017/2018. The trials included 21 varieties which were present on more than 82% of total sown area of mercantile wheat. During testing period, varieties were replaced and thus the share of premium and class I varieties increased and the share of III and IV class reduced. In year 2015, the 57.19% of varieties in the production were of classes III and IV, and in the year 2018 the share of III and IV class was reduced to 18.29%. The premium and class I share in year 2015 was 12.79%, while in year 2018 premium and I class share was increased to 64.54%. The obtained results show an increase of premium and I class share by selecting new high quality wheat varieties.

Keywords: wheat, assortment, purchase, codex, high quality

THE POTENTIAL OF BARLEY FOR BIOFORTIFICATION

Zdenko Lončarić[1*], Andrijana Rebekić[1], Gordana Šimić[2], Ivan Abičić[2], Darko Kerovec[1], Alojzije Lalić[2]

[1]Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, 31000 Osijek, Croatia
[2]Agricultural Institute Osijek, Južno predgrađe 17, 31000 Osijek, Croatia
[*]corresponding author: zdenko.loncaric@fazos.hr

invited lecture

More than two billion people are exposed to malnutrition, with the lack of zinc being the general problem and the lack of selenium a regional problem. Therefore, 36 barley genotypes were grown in a field experiment with biofortification by 5 or 10 g/ha of foliarly applied selenium. The average protein concentration in whole grain flour without selenium application was 9.14% (range 7.95 - 10.05%) and the zinc concentration was 16.71 to 21.90 mg kg^{-1} (19.17 on average). The analysed genotypes differ significantly in zinc concentrations, irrespective of the selenium application. In addition, the genotypes differed significantly in terms of protein content and selenium concentrations, and the highest variability was determined after biofortification with a higher dose of selenium. The selenium concentration in barley grains without Se application was very low, just 45 µg/kg on average, but the foliar application of 5 and 10 g Se/ha significantly increased the Se in the grain to 178 and 299 µg/kg on average, which are 4 and 6.6 times higher Se concentrations. Moreover, there were significant differences in genotypes regarding the increase in Se concentrations, from 177 to 511 µg/kg after the application of a higher Se dose. At the same time, biofortification with selenium did not affect zinc concentration, but it had a very significant effect on the protein concentration, with the lowest protein content being in the control treatment without selenium. Considering the average Se concentrations in whole grain barley flour, 1.22 kg of regular flour would be needed for the intake of 55 µg of Se as a mean daily recommendation, but just 309 or 184 g of flour biofortified with a lower or a higher Se dose would be enough. These facts and the specificity of barley genotypes indicate the high potential of barley for biofortification.

Keywords: zinc, selenium, malnutrition, protein, flour

TRENDS IN FLOUR BASED CONFECTIONARY

Sanja Oručević Žuljević*

University of Sarajevo, Faculty of Agriculture and Food Sciences,
Zmaja od Bosne 8, 71000 Sarajevo, Bosnia and Herzegovina
*corresponding author: s.orucevic-zuljevic@ppf.unsa.ba

invited lecture

Confectionary products are defined by the presence of sugars and characterized by the sweet taste. On the basis of ingredients, production methods, and final product, those products are divided into two main groups: sugar confectionery (candies, caramels, chocolates, cocoa, etc.) and flour confectionery (biscuits, cookies, crackers, wafers, etc.). Flour based confectionary products present one of the most often consumed baking products and their growth in market has been increasing per capita consumption around the world. Sugar and fat are main ingredients in sweet products which contribute to high energy value. Nevertheless, they are low in micronutrients and generally poor in nutritive sense. Nowadays, the confectionary is faced with different challenges: to reduce energy value and, at same time, to increase nutritive value in order to produce healthier foods that meet consumers' expectations. However, energy value in confectionary products can be reduced by reducing saccharose, as well as other high energy value and glycemic index carbohydrates, substituting them partially or completely by different sweeteners, reducing fat in formula and/or replacing fat using alternative materials. In addition, nutritive value can be improved using whole meal flour instead white, using other cereals with evident considerable nutritive value and adding fruit and the other high nutritive ingredients. Improving general quality of flour based confectionery products is a common topic of many recent research studies covered by different fields.

Keywords: flour based confectionary products, improving nutritive value, reducing energy value

PREFERENCE OF BREAD, BREAD ROLLS, AND BREAKFAST CEREALS DEPENDING ON THE FLOUR TYPE

Darja Sokolić*

Croatian Agency for Agriculture and Food, Center for Food Safety, I. Gundulića 36b, 31000 Osijek, Croatia
*corresponding author: darja.sokolic@hapih.hr

invited lecture

Grain has been an integral part of nutrition for thousands of years. Next to carbohydrates, proteins, and fats, it is also a source of vitamins and minerals. It also provides a significant source of fibre, if consumed as whole grain. In the Republic of Croatia, bread and bread rolls are consumed on a daily basis, even several times a day. The first research on eating habits conducted among the adult population in the Republic of Croatia showed that half-and-half bread and bread rolls are most commonly consumed, both in quantity and in frequency. Regionally, people in Slavonia mostly consume white bread and bread rolls, while the people from the Zagreb region mostly consume whole grain products. Men consume bread and bread rolls more often and in larger quantities. The younger population prefers the consumption of white bread, while the preference decreases with age, and the consumption of half-and-half bread, as well as whole grain products, increases. Breakfast cereals are consumed by women four times more often than by men, while looking at the situation regionally, Slavonia and the Zagreb region lead in the quantity of consumption. It is interesting to note that the consumption of breakfast cereals increases by 60% after the age of 45.

Keywords: bread, bread rolls, breakfast cereals, food consumption, Croatia

EFFECTS OF RESISTANT STARCH TYPE 4 AND WHEAT BRAN ON DOUGH AND BREAD PROPERTIES

Merve Arıbaş[1*], Hamit Köksel[2]

[1]Aksaray University, Food Engineering Department, Aksaray, Turkey
[2]Hacettepe University, Food Engineering Department, Ankara, Turkey
[*]corresponding author: mervesert@aksaray.edu.tr

oral presentation

Resistant Starch (RS) is defined as the fraction of starch which escapes digestion in the small intestine. The physiological effects of RS are similar to those of dietary fibre. RS has potential health benefits but it has lower impact on sensory properties of foods compared with traditional sources of fibre, such as bran. It provides better appearance, texture, and mouthfeel than conventional fibres. The aim of the present study was to determine the effects of Resistant Starch Type 4 (RS4) and wheat bran (WB) addition on rheological properties of dough and the textural and colour properties of bread. Although RS4 did not have a great effect on farinograph water absorption (0.7% increase), the WB resulted in a >4% higher water absorption as compared to the control flour sample. RS4 caused slight decreases in the Alveograph P value, while WB resulted in a considerable increase. Both RS4 and WB had a decreasing effect on the Alveograph W value. Decreases were observed in loaf volumes of RS4 supplemented breads as the supplementation level increased. However, the loaf volume of bread supplemented with WB was lower. Crust L* and b* values of the breads increased significantly with the increasing level of RS4 supplementation, but the supplementation of WB caused a decrease. Significant increases in the firmness values of RS4 supplemented breads were observed as the supplementation level increased. The firmness value of WB supplemented bread was significantly higher as compared to the breads supplemented with RS4 at all levels. The results indicated that RS4 provides better volume, texture, and rheology than WB.

Keywords: Alveograph, bread, Farinograph, enzyme resistant starch

CEREAL BASED FOOD INDUSTRY - ECONOMIC POINT OF VIEW

Marijana Blažić*, Lahorka Halmi, Kornelija Severović

Karlovac University of Applied Sciences, Trg J.J.Strossmayera 9, 47000 Karlovac, Croatia

*corresponding author: marijana.blazic@vuka.hr

oral presentation

The present globalization has brought many new directions in the eating habits of the population. By eliminating cultural, informational and other boundaries, there are many opportunities to improve life. Prerequisite for the improvement is the economy that enables the development of the food industry on the basis of market preference. The manufacturing industry is a significant factor in every economy, with a focus on the food industry, which occupies a significant position, both by the number of employees and by the share of the gross domestic product. In Europe, bakeries occupy a very important position in the national economy. In support of the mentioned is the data on the annual income of the bakeries in 2012, which is amounted to 98.4 billion euros. In the same year, in Europe, bakery is the first sub-sector of the food industry by the number of companies (53.7% of all food companies) and by job positions (1.36 million jobs, 32% of all jobs in the food industry in Europe).

In recent years, during the crisis and emerging from the crisis, the bakeries are affected by the low-cost product demand, which has led to a reorientation of the business with the focus on reducing the cost component in order to achieve a positive business. In addition to technological changes, there is a change in the supply of raw materials. Life habits of the population are changing, with a growing health-oriented lifestyle. Very often, there is a strong need for food without gluten. The product range is becoming more and more complex. All this significantly influences the decision on entrepreneurial venture in bakery. Starting from the general economic situation, influenced by many changes in the business environment, the aim of this article is to further deepen the theoretical knowledge about entrepreneurship in bakery in terms of the fundamental components of entrepreneurship and bakery.

Keywords: food industry, bakery, bread, entrepreneurship

CHALLENGES OF THE USE OF LACTIC ACID FOR BREAD PREPARATION - COMPARISON STUDY: LACTIC ACID OR LACTO-FERMENTATION

Vita Lele[1*], Vadims Bartkevics[2], Iveta Pugajeva[2], Sigrid Mayrhofer[3], Konrad Domig[3], Elena Bartkiene[1]

[1]Lithuanian University of Health Sciences, Tilzes str. 18, LT47181 Kaunas, Lithuania
[2]University of Latvia, Centre of Food Chemistry, Kr. Valdemara iela 48, LV1013 Riga, Latvia
[3]University of Natural Resources and Life Sciences, Muthgasse 18, 1190 Wien, Austria
[*]corresponding author: vita.lele@lsmuni.lt

oral presentation

In this study, lactic acid bacteria (LAB) from spontaneously fermented rye flour were isolated, identified, and characterized. The main properties of the isolated strains were evaluated: acidification rate, carbohydrate metabolism, and growth. The isolated and characterized LAB were used for the production of rye sourdough and the influence of sourdough on the quality and safety parameters (*L*-(+)-lactic acid, acrylamide (AA) formation) of rye-wheat bread (RWB) was evaluated. Also, a comparative experiment by using *L*-(+)-lactic acid (LA) for RWB preparation was performed. *L. plantarum, P. acidilactici,* and *L. curvatus* demonstrated high acidic tolerance, good growth at 30-37 °C, and versatile carbohydrate metabolism. When the isolated LAB strains were used for rye flour fermentation, they showed obvious acidification rates while excreting proteolytic and amylolytic enzymes. Fermented rye flour delayed bread staling and there was a significant influence of the type of dough acidification (with *L*-(+)-LA or LAB) and the amount of the acidification agent used on most of the analysed quality and safety parameters of RWB. *L. plantarum* sourdough (5% and 15% by mass) decreases the AA content in RWB samples ($p<0.0001$), opposite to dough acidification with *L*-(+)-LA. Finally, the selected LAB can be recommended for reducing AA content and improving the quality and safety of RWB.

Keywords: *Lactobacilli*, acrylamide, wheat bread, quality, mixed rye

Acknowledgements:
The authors gratefully acknowledge the COST Action CA18101 "SOURDOugh biotechnology network towards novel, healthier and sustainable food and bIoproCesseS".

COMPLEX COMPARISON OF THE EFFECT OF QUINOA AND CANAHUA WHOLEMEAL FLOURS ON THE QUALITY OF COMMERCIAL WHEAT FLOUR

Ivan Švec[1*], Marie Hrušková[1], Taťána Hofmanová[1], Rasa Kapačinskaitė[2]

[1]Department of Carbohydrates and Cereals, University of Chemistry and Technology Prague, Technická 5, 166 28 Prague 6 – Dejvice, Czech Republic
[2]Department of Food Science and Technology, Kaunas University of Technology, Kaunas, Lithuania
[*]corresponding author: ivan.svec@vscht.cz

oral presentation

Quinoa and canahua (kaniwa) wholemeal flour, substituting 10 or 20 wt. % of wheat, were prepared under laboratory conditions. Using operational tests, Zeleny sedimentation, and the Falling Number, both non-traditional materials caused about a 10% decrease of both. The amylograph test results were affected by very low amylase activity in wheat flour, as well as by the high absorption capacity of canahua and quinoa – the samples could be partly distinguished according to the beginning temperature of gelatinization. The Rapid Visco Analyser profiles of pure flours differed clearly – both alternative materials did not demonstrate a viscosity peak and differed in starch retrogradation rate during the heating and cooling phases of the test. Wheat flour replacement by both raw materials varied the peak viscosity values significantly. During the testing on the farinograph, quinoa partially increased water absorption and the higher amount of water was reflected in the stability of dough consistency during mixing, and its weakened cohesiveness at the end of the test. The effect of canahua was unequivocal – water absorption decreased, stability was prolonged properly, but dough softening increased. The extensograph test confirmed the positive effect of alternative crops on dough elasticity, but in general, the composite dough with 20% of canahua or quinoa had worsened its machinability. The fermentograph and the maturograph tests showed difference in the optimal fermentation and proofing times, as well as dough volumes during both tests (which were somewhat higher for the wheat-quinoa flour composites). Aside from that, dough volumes within the third stage of fermentation simulated on the oven-rise apparatus decided the baking trial results; in this regard, the wheat-canahua flour composites reached statistically better results. Aside from that, the different colour of yellow quinoa and black-red canahua were reflected in the tint of the bread crust and crumb. Both alternative materials introduced their typical aroma and taste, less unpleasant for the 10% addition, for both canahua and quinoa. All gained data, together with sensory scores, pointed to the maximum tolerable quinoa or canahua dosage of up to 15 wt. %.

Keywords: wheat composite flour, quinoa, canahua, rheology, bread, PCA

PROTECTING THE QUALITY OF GRAIN

Michael Reitter*

Treatment of grains through conservation cooling with the GRANIFRIGOR™, Frigortec, Amtzell, Germany
*corresponding author: anja.mohoric@actor.si

sponsor advertisement presentation

Grain is one of our most vital staple foods. It is farmed and harvested with great care. According to the Food and Agriculture Organisation of the United Nations (FAO), the annual spoilage of the grain harvested worldwide is over 20%. The major part of this loss results from insect activity and mildew growth. The use of the GRANIFRIGOR™ conservation cooling process effectively prevents these losses. Many million tonnes of grain, seed oil, rice, maize, and other cereals are conserved worldwide using this technology. Losses in freshly harvested grain are caused by the grain's cellular respiration and its consequent spontaneous heating. This process is dependent on the grain's moisture content and temperature. The consequences of spontaneous heating are loss of substance and the propagation of insects and mildew. Conservation cooling means that winter climate conditions are brought forward to the post-harvest period, and are thus availabe immediately after the harvest. Once grain has been cooled, it remains cold over a long period. These days more dry grain is cooled than moist – mainly to protect against feeding and proliferating insects. Losses through insect feeding can effectively cease by cooling the harvested crop to temperatures under 13 °C. If the temperatures are low enough, the insects go into diapause – hibernation – and cannot harm the stored crop. The use of the GRANIFRIGOR™ grain-cooling method minimises dry substance losses and prevents loos of quality through insect feeding and generation of mildew.

Keywords: grains, quality, conservation cooling, insects, mildew

INFLUENCE OF THE HIGH-VOLTAGE ELECTRICAL DISCHARGE TREATMENT ON SELECTED PROPERTIES OF MAIZE STARCH

Ivanka Grgić[1], Đurđica Ačkar[2*], Marijana Grec[2], Jelena Panak Balentić[2], Antun Jozinović[2], Drago Šubarić[2], Nebojša Kojić[3], Jurislav Babić[2]

[1]Institute of Public Health of the Brod-Posavina County, V. Nazora 2A, 35000 Slavonski Brod, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[3]VUPIK plus d.o.o., Sajmište 113C, 32000 Vukovar, Croatia
[*]corresponding author: dackar@ptfos.hr

poster presentation

The aim of this research was to investigate the influence of the high-voltage electrical discharge treatment (HVED) on the modification of maize starch. Maize starch was treated with HVED (70 Hz; 30 min), Na_2HPO_4 (2.5%), $Na_5P_3O_{10}$ (2.5%), and by a combination of the HVED treatment with each chemical modification. Amylose content was determined by the Megazyme K-AMYL 07/11 method, resistant starch (RS) content by the AOAC 2002.02 method, damaged starch (DS) by the AACC 76-31.01, and SEM micrographs were taken.
The results revealed that the HVED treatment does not significantly influence the amylose and resistant starch content, but it enhances the effect of chemical modifications on these properties, reducing both the amylose and RS contents. Starch damage, contrary to expectation, decreased after all the modification processes. The SEM analysis revealed physical damage to starch granules by the HVED.

Keywords: HVED, corn starch, phosphorylation, resistant starch, SEM

Acknowledgements:
The research was financed in part by Josip Juraj Strossmayer University of Osijek under the project "Application of gas plasma and ultrasound in starch modification processes".

WHEAT BREAD WITH LACTO- FERMENTED SAVORY PLANTS

Elena Bartkiene[1*], Vita Lele[1], Paulina Zavistanaviciute[1], Vytaute Sakiene[1], Egle Zokaityte[1], Iveta Pugajeva[3], Vadims Bartkevics[2,3], Daiva Zadeike[4], Grazina Juodeikiene[4]

[1]Lithuanian University of Health Sciences, Tilzes str. 18, LT-47181 Kaunas, Lithuania
[2]University of Latvia, Jelgavas iela 1, LV-1004 Riga, Latvia
[3]Institute of Food Safety, Animal Health and Environment, Lejupes iela 3, LV-1076 Riga, Latvia
[4]Kaunas University of Technology, Radvilenu str. 19, LT-50254 Kaunas, Lithuania
[*]corresponding author: elena.bartkiene@lsmuni.lt

poster presentation

In this study the influence of savory plants (SPl) belonging to *Thymus vulgaris*, *Carum carvi*, *Origanum vulgare*, *Ocimum basilicum*, and *Coriandrum sativum*, scalded flour (ScF), as well as sourdough fermented with *Lactobacillus plantarum* strain on the quality and safety characteristics of the wheat bread was investigated. It was established that the formation of acrylamide (AA) in wheat bread, as well as bread quality parameters were significantly influenced by the variety of SPl used for scald preparation, and the amount of ScF and the sourdough used. The addition of the *T. vulgaris* and ScF increased the concentration of AA by 300%, compared with bread prepared without ScF. However, the addition of *L. plantarum* sourdough significantly reduced the concentration of AA in wheat bread. The highest effectiveness in AA reduction was exerted using 5% of *L. plantarum* sourdough supplemented with *O. vulgare* and with 15% of *L. plantarum* sourdough supplemented with *C. sativum* (AA reduced by 40% and 29.4%, respectively). Finally, the addition of 5% of scalded wheat flour fermented with *L. plantarum* strain and supplemented with *Origanum vulgare*, as well as 5% or 10% of *L. plantarum* sourdough supplemented with *Ocimum basilicum*, and 15% of *L. plantarum* supplemented with *Coriandrum sativum* significantly reduced AA in wheat bread, and can be recommended for safer bread preparation.

Keywords: acrylamide, scald, fermentation, savory plants, wheat bread, quality

Acknowledgements:
The authors gratefully acknowledge the COST Action CA18101 „SOURDOugh biotechnology network towards novel, healthier and sustainable food and bIoproCesseS".

SENSORY PROPERTIES OF GLUTEN-FREE BREAD WITH PEA FLOUR AND IMPROVEMENT AGENTS

Saša Drakula*, Valentina Budimir, Marina Krpan, Dubravka Novotni, Bojana Voučko, Nikolina Čukelj Mustač, Mirjana Hruškar, Duška Ćurić

University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, 10000 Zagreb, Croatia
*corresponding author: sdrakula@pbf.hr

poster presentation

Sensory perception plays a key role in the consumers' choice of bread. The addition of legume flour in gluten-free bread can improve its usually low nutritional value, but could have a negative effect on its sensory properties. The aim of this study was to perform descriptive and hedonic analyses of the odour, taste, aroma, texture, and appearance of gluten-free bread prepared without and with pea flour addition (25%, flour basis). Bread with added pea flour was also prepared with the addition of potential improvers – sourdough (10%, 20%, or 30%, dough basis), proline, and fructose (0.1% and 1%, flour basis, respectively). Sourdough was prepared with *Lactobacillus brevis* DSM 20054 as a starter, with the addition of arginine (0.1%, flour basis) and protease (0.25%, protein basis). According to the descriptive analysis (14 panellists), bread without added pea flour was characterized by its less pronounced taste, but more pronounced 'fresh bread-like' odour and aroma, lighter crumb/crust colour, lower crumb porosity, and moister and stickier texture. In contrast, bread with added pea flour and improvers was characterized by more pronounced 'burnt-like' and 'caramelised sugar-like' odour, 'dough-like' aroma, and 'pea-like', 'nut-like', 'fat-like' sour odour and aroma. Higher sourdough addition led to darker crumb/crust colour, higher crumb porosity, less crumbly texture, less pronounced 'pea-like' odour and aroma, more pronounced 'baked-like' odour, and 'popcorn-like' and 'fresh bread-like' aroma. Bread with 30% sourdough was the most preferred by consumers (n=58), being graded as 'moderately liked'. Gluten-free bread with pea flour that contains improvement agents has enhanced sensory properties when compared to gluten-free without pea flour.

Keywords: descriptive analysis, gluten-free bread, hedonic analysis, pea flour, sourdough

THE EFFECT OF FREEZING CONDITIONS AND FROZEN STORAGE ON THE PHYSICAL AND SENSORY PROPERTIES OF PUFF PASTRY

Anastasija Selaković[1], Olivera Šimurina[2], Dragana Šoronja-Simović[1], Jana Zahorec[1], Bojana Filipčev[2*], Zita Šereš[1]

[1]University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
[2]University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
[*]corresponding author: bojana.filipcev@fins.uns.ac.rs

poster presentation

The aim of this paper was to investigate the impact of freezing conditions on the quality of puff pastry. The impact of blast freezing temperatures (-25, -30, -35 °C) and the temperatures in the centre of the dough piece (-10, -15 , -20 °C) on the quality of frozen puff pastry after storage at -18 °C, during 1, 7, and 30 days, was investigated by means of response surface methodology. The desirability function was employed to optimize the effects of freezing conditions. The responses were physical properties (pastry lift, volume) and sensory score (flakiness, flakiness uniformity, pore size, layer thickness, and colour uniformity). The highest quality score was attributed to the samples frozen at -35 °C that reached -10 °C in the centre. These samples exhibited 4.5 times higher pastry lift during baking and accordingly, the highest volume and the best sensory properties. After 7 days of storage of the frozen dough, the pastry lift and volume deteriorated. However, the sensory quality of puff pastry remained unchanged, retaining the same level as that after 1 day of frozen storage (the total score was 17.1 points out of the maximum 20 points). Thermogravimetric analysis (TGA) was performed to analyse the release of water from the pastries. The deconvolution of TGA curves revealed that there was an alteration in water populations associated with gluten among the samples. After 7 days of storage, in the best scored samples, the peak associated with water bound to gluten exhibited a shift to a significantly higher evaporation temperature. In contrast, other samples showed either lower evaporation peaks or an absence of a peak related to water population bound to gluten, which implies that freezing conditions affect the water redistribution and the water-binding ability of the gluten network.

Keywords: blast freezing, quality, pastry lift, volume, sensory score, TGA, water population

VOLATILE COMPOUNDS AND SHELF-LIFE OF LOW-SODIUM BREADS WITH ADDED AROMATIC PLANTS

Emilija Friganović[1*], Mladenka Šarolić[1], Boris Dorbić[1], Zvonimir Marijanović[2]

[1]Marko Marulić Polytechnic of Knin, P. Krešimira IV 30, 22300 Knin, Croatia
[2]University of Split, Faculty of Chemistry and Technology, Department of Food Technology and Biotechnology, Ruđera Boškovića 3, 21000 Split, Croatia
[*]corresponding author: efriganovic@veleknin.hr

poster presentation

In the present study volatile compounds and shelf-life of low-sodium breads with the added aromatic plants (ground spices) were studied. The main ingredients of tested breads were wheat flour, water, ground spices (wild thyme, chives and basil), yeast and salt (max. 0.12 g of sodium per 100 g of bread). Volatiles were determined using headspace solid phase microextraction (HS-SPME) with a PDMS/DVB fibre coat followed by gas chromatography mass-spectrometry (GC-MS). A total of 22, 13 and 12 compounds were identified in bread with wild thyme (A), chives (B) and basil (C), respectively. The major compounds in bread A were thymol (50.32%), *p*-cymene (13.86%), *trans*-anethole (6.07%), methyl thymyl ether (5.43%), cravacrol methyl ether (5.23%), carvacrol (3.34%) and *trans*-caryophyllene (3.19%); in bread B *trans*-anethole (45.11%), carvone (12.44%), (*E*)-hept-2-enal (6.28%), camphor (4.06%), oct-1-en-3-ol (3.34%) and 2-phenylethanol (3.08%); in bread C *p*-allylanisole (24.59%), linalool (21.12%), β-burbonene (19.03%), *trans*-anethole (13.41%), *trans*-α-bergamotene (5.43%), undecanal (4.23%) and carvone (3.02%). The identified volatiles were specific for each aromatic plant and thus expected. Breads were stored under ambient temperature (25 ± 1 °C) and their moisture content, water activity and overall acceptability were estimated at 2 days interval for 20 days. The examined aromatic plants extended the shelf-life and showed antifungal activity, and the best effect showed bread with the added wild thyme, then chives and finally basil.

Keywords: bread, aromatic plants, volatiles, HS-SPME/GC-MS, shelf life

PROPERTIES OF STARCH ROASTED WITH APPLE DISTILLERY WASTEWATER

Tomasz Zięba[1], Dominika Solińska[1], Małgorzata Kapelko-Żeberska[1], Artur Gryszkin[1*], Đurđica Ačkar[2], Ante Lončarić[2], Jurislav Babić[2], Antun Jozinović[2]

[1]Wroclaw University of Environmental and Life Sciences, Faculty of Biotechnology and Food Technology, Chelmonskiego Street 37, 51-630 Wroclaw, Poland
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[*]corresponding author: artur.gryszkin@upwr.edu.pl

poster presentation

The use of chemicals in the food industry raises concerns among an increasing number of consumers. The application of organic acids, occurring naturally in plant materials, for starch esterification may represent an alternative to the methods for its chemical modification. This study is aimed at producing starch esters by roasting potato starch with apple distillery wastewater at various temperatures and to determine the effects of esterification conditions on the selected properties of the modified preparations. Apple distillery wastewater was concentrated, mixed with starch (30 g of dry matter per 100 g of starch), dried, and roasted at temperatures of 110, 130, or 150 °C for 3 hours. The resultant preparations were rinsed 30 times with a 60% ethanol solution, dried, and disintegrated. After that, the following analyses were performed: the content of substituted acids (after base de-esterification) with liquid chromatography (HPLC); pasting parameters based on DSC thermal characteristics; swelling power and solubility in water at the temperature of 80 °C; colour changes with a colorimeter; rheology of the pastes based on plotted flow curves; and the resistance of pastes to amyloglucosidase.
Starch esterification was effective at the temperatures of 130 and 150 °C, and in these cases starch was esterified with malic, citric, formic, and maleic acids. Roasting at 110 °C only caused negligible esterification with malic acid. Starch treatment with apple distillery wastewater at 130 and 150 °C caused changes in its properties compared to the control samples, including: lower temperature and heat of pasting, lower swelling power and solubility in water, darker colour, higher resistance to amyloglucosidase, and formation of pastes with lower viscosity.

Keywords: starch, esterification, apple distillery wastewater

Acknowledgements:
This work has been supported by the Josip Juraj Strossmayer University of Osijek under the project "Potential of application a distillery wastewater from the production of apple brandy for the production of naturally modified starches" (UNIOS-ZUP 2018-26).

THE CHANGES OF MINERAL COMPOSITION OF WHEAT AND CORN GRAINS OVER THE PAST CENTURY

Zoltán Győri*

University of Debrecen, 138 Böszörményi street, H-4032 Debrecen, Hungary
*corresponding author: gyori.zoltan@unideb.hu

poster presentation

Today, the attention of food and nutrition researchers is increasingly turning to the fact that the grain quality of wheat and corn has changed over the past century. Wheat and maize are one of the most important raw materials for human and animal nutrition. Extensive research studies are conducted in order to investigate both organic and inorganic chemical components, with the aim of making a comparison between old and new varieties. Since there are still 50-70 year-old cultivars, it is possible to conduct an analysis on a number of ingredients. If "museum" samples need to be analyzed, it is advised to determine the mineral components, since they have minimal oxidation loss.

In our research, we tried to find out what kind of changes have occurred in case of Hungarian wheat varieties and corn hybrids by comparing the archived and cultivated cultivars as a result of various effects (fertilization, crop protection, CO_2 emission, climate change, variety changes, fertilizer supplements). Inductively coupled plasma mass spectrometry (ICP – MS) measurements also included assessment of phosphorus, potassium, calcium, magnesium, iron, manganese, zinc, copper and strontium content. We found the decrease of iron and zinc content in the new cultivars compared to the old ones and the tendency has become more salient since the 1960's , as intensive cultivar change was introduced. In addition, an increase of calcium and strontium in new wheat varieties was found as well. There was no change in corn when the measurement methods were the same on the different samples.

The results can help researchers and practitioners interested in the topic of nutrition science create a realistic picture of the changes of mineral composition.

Keywords: winter wheat, corn, mineral composition, long term study

IMPACT OF CRICKET (*ACHETA DOMESTICUS*) FLOUR ADDITION ON THE VISCOMETRIC PROFILES OF FLOUR MIXTURES

Joanna Harasym[1,2*], Agnieszka Orkusz[1,2], Urszula Kaim[1,2]

[1]*Adaptive Food Systems Accelerator – Science Centre, Wrocław University of Economics, Poland*
[2]*Department of Biotechnology and Food Analysis, Institute of Chemistry and Food Technology, Wrocław University of Economics, Poland*
[*]corresponding author: joanna.harasym@ue.wroc.pl

poster presentation

Cricket flour from *Acheta domesticus* can be an important source of protein and is perceived as a food product ingredient. The main constituents of the cricket body are protein, chitin and fat, which are distributed in the cricket body. Crickets usually contain about 71-73% of water, therefore, in dried mass the distribution is quite different. As protein, fat, and chitin are perceived as ingredients impacting the viscometric behaviour of flour mixtures, such characteristic should be taken when planning their wider usage in products. Commercially available cricket flour contains 69.1% of protein, 18.5% of fat and 7.7% of fibre, other carbohydrates 0.7% and salt 1.03%. Such high content of proteins and fat can significantly impact the viscosity of gels made from flour mixtures.

The main objective of this study was to investigate the viscosity changes by the viscometric profile obtained with an RVA standard 1 method of flour mixtures composed of rice flour and house cricket flour. Both flours where purchased commercially and six mixtures were prepared to contain 5%, 10%, 15%, 20%, 25% and 30% of cricket flour. The pasting properties were taken both in water and in 0.01 M $AgNO_3$ to investigate the enzyme activity impact.

The progressing addition of cricket flour gradually lowered the peak viscosity (PV) of mixtures. However, the samples measured in 0.01 M $AgNO_3$ revealed higher PV values for mixtures of higher cricket flour addition. The pasting temperature was constantly rising with an increasing amount of cricket flour in mixtures, while the final viscosity differences were lower between samples indicating the additional activity present in samples.

Keywords: pasting properties, edible insects, rice flour, *Acheta domesticus*

WHEAT PROTEINS: QUANTITATIVE DISTRIBUTION UNDER NITROGEN FERTILISATION

Daniela Horvat*, Gordana Šimić, Krešimir Dvojković, Marko Ivić, Ivana Plavšin, Dario Novoselović

Agricultural Institute Osijek, Južno predgrađe 17, 31000 Osijek, Croatia
*corresponding author: daniela.horvat@poljinos.hr

poster presentation

Grain protein composition and content are crucial for wheat baking quality. It is common practice to use late nitrogen (N) application to increase grain protein content (P) of wheat. Whole flours of 8 wheat cultivars were characterised by the quantitative determination of total P and their main groups (albumins and globulins - AG, gliadins – GLI, and glutenins - GLU) using NIT (Infratec 1241) and HPLC procedures. The cultivars were grown at the Agricultural Institute Osijek during two seasons, at two levels of nitrogen (N) fertilisation. The total amount of the applied N was 77 kg ha^{-1} and 177 kg ha^{-1} of N, without and with top-dressing, in the 2017 season, and 102 kg ha^{-1} and 202 kg ha^{-1} of N in the 2018 season, respectively. On average, the P content under N supply was increased by 15.5% in 2017 and by 13.3% in 2018 (12.0% *vs.* 13.9% and 12.3% *vs.* 13.9, respectively). The proportion of AG in 2017 was increased in comparison to 2018. The GLI consistently increased in both years, unlike the GLU that decreased. On average, a significant increase in total P resulted in an increase in the GLI/GLU ratio (1.33 *vs.* 1.53) due to increased monomeric GLI synthesis after N fertilization. The extent of the N's effects on proteins was strongly dependent on cultivars.

Keywords: wheat, cultivars, nitrogen, proteins, HPLC

Acknowledgement:
This paper has been financed by the grant of the Croatian Science Foundation IP-2016-06-2178 and the project KK.01.1.1.01.0005 Biodiversity and Molecular Plant Breeding, Centre of Excellence for Biodiversity and Molecular Plant Breeding (CoE CroP-BioDiv), Zagreb, Croatia.

POSITIVE EFFECTS OF BARLEY ON HUMAN HEALTH

Nada Knežević[1*], Mario Ivanuša[2], Marina Palfi[1]

[1]Podravka d.d., Research and Development, Ante Starčevića 32, 48000 Koprivnica, Croatia
[2]Institute for Cardiovascular Prevention and Rehabilitation, Draškovićeva 13, 10000 Zagreb, Croatia
[*]corresponding author: nada.knezevic@podravka.hr

poster presentation

Significant increase in cardiovascular (coronary heart disease, hypertension and stroke) and metabolic diseases (type 2 diabetes, metabolic syndrome and insulin resistance) and the growth of global obesity represent major problems of today. A proper and nutritiously balanced diet is one of the main prerequisites for a healthy way of life. Due to the increased quantity of scientific evidence that the wholegrain and wholegrain-based products not only provide us with energy and nutrition, but also have a positive effect on human health, there are more and more recommendations to include these ingredients in the everyday diet. Barley is the fourth most often produced cereal in the world with the annual production of around 140 million tons. It is rich in nutrients and functional ingredients, and is an especially important source of beta glucan.
Based on scientific opinions, the European Food Safety Authority (EFSA) has approved three health claims pursuant to the Article 13(1) and two health claims pursuant to the Article 14(1)(a) of Regulation (EC) No 1924/2006 which are connected with barley and beta glucan from barley. Although the barley has been used since ancient times, new scientific findings give additional stimulation to users to consume barley, but also the food industry to develop barley-based products.

Keywords: barley, β-glucan, cardiovascular and metabolic diseases, health statement, functional food.

CULTURAL-HISTORICAL HERITAGE OF THE KARLOVAC COUNTY – HOMEMADE BREAD AS A GASTRONOMIC TOURIST PRODUCT IN RESTAURANTS IN THE KARLOVAC COUNTY

Draženka Birkić, Davorka Rujevčan, Elizabeta Kralj*, Marijana Blažić

Karlovac University of Applied Sciences, Trg J.J. Strossmayera 9, 47000 Karlovac, Croatia

*corresponding author: elizabeta.kralj@vuka.hr

poster presentation

Tourism can provide a strong contribution and a boost to the protection of intangible cultural-historical heritage, among which gastronomy plays an important role. In this respect, we have investigated to what extent is homemade bread recognized as an authentic indigenous gastronomic product by the owners and restaurant managers in the Karlovac County. This was performed by the use of various scientific methods, such as field research methods, desk research methods, descriptive methods, deductions, descriptive statistics, synthesis, and semi structured interviews with target group representatives, owners, and restaurant managers in the Karlovac County. The research results suggest that gastronomy, as a modern and sophisticated tool for the interpretation of intangible cultural-historical heritage, can significantly contribute to its efficient preservation, while it develops and raises the quality of the tourist product at the same time. Homemade bread, made according to the original recipe, can also make an efficient contribution to the preservation of intangible cultural-historical heritage, while raising the quality of the tourist product at the destination level at the same time. However, it is not sufficiently exploited.

Keywords: gastronomic tourist product, homemade bread, intangible cultural-historical heritage, Karlovac County

THE OPTIMIZATION OF BISCUIT FORMULATION WITH GRAPE AND ARONIA POMACE AS COCOA SUBSTITUTES

Dunja Molnar, Dubravka Novotni*, Mario Ščetar, Tomislav Bosiljkov

Faculty of Food Technology and Biotechnology, University of Zagreb Pierottijeva 6, 10000 Zagreb, Croatia
*corresponding author: dnovotni2@pbf.hr

poster presentation

By-products of fruit processing, such as grapes and aronia pomace, are rich in fibre and polyphenols, and their application in bakery products could significantly improve the nutritional value of those products. This research is aimed at optimising whole grain biscuit formulation with grape and aronia pomace as a partial substitute for cocoa powder, using the desirability function. Ten formulations with the mixture of cocoa powder, grape, and aronia pomace in different ratios (0-100%) were tested. The physical properties (texture, colour, thickness, diameter, spread factor) and the sensory acceptability of biscuits were investigated. The interaction of all three mixture components significantly affected the instrumentally measured hardness, redness *a**, and liking of texture. Biscuit diameter, yellowness *b**, and liking of taste were affected by the interaction of aronia and grape pomace. Biscuit height, spread ratio, flexibility, appearance, and odour were not significantly influenced by the mixture composition. The optimized mixture composition contained cocoa, grape pomace, and aronia pomace in the ratio 76.4 : 15.5 : 6.1 (respectively), with the desirability of 0.73. After confirmation, biscuits with that mixture were proven better than the control, that contained 100% cocoa, in terms of decreased hardness (-23%) and toughness (-19%), having the same sensory acceptability. The findings of this study indicate that aronia and grape pomace could be used as a partial replacement for cocoa in the production of functional biscuits, aiding in the sustainability of the food chain.

Keywords: aronia pomace, grape pomace, biscuit, cocoa replacement, desirability

THERMOPHYSICAL PROPERTIES OF SOUR CHERRY FILLINGS

Nela Nedić Tiban*, Ana Živić, Mirela Kopjar

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
*coresponding author: nela.nedic@ptfos.hr

poster presentation

The fruit fillings designed for bakery products are expected to be stable not only at high temperatures, but also under different storage conditions, such as freezing.
The aim of this study was to investigate the influence of sugars (trehalose and sucrose) and hydrocolloids (guar gum and xanthan) on thermophysical properties of sour cherry fillings. Sour cherry fillings were prepared by mixing juice with 0.6% of hydrocolloids and 50% of sugars. The thermal analysis of the sour cherry fillings was performed using a differential scanning calorimeter. Samples were analysed by two different methods, depending on the starting temperature of measurement (25 °C or - 60 °C). The parameters of the crystallisation (Tc$_o$-onset, Tc$_p$-peak, Tc$_e$-endset and enthalpy of crystallisation-ΔHc), glass transition (onset and midpoint temperatures - Tg'$_o$ and Tg'$_m$ and change of specific heat capacity-Δc_p) and melting (Tm$_o$-onset, Tm$_p$-peak, Tm$_e$-endset and enthalpy of melting-ΔHm) were monitored. As expected, sour cherry juice had the highest melting temperatures (Tm$_o$, Tm$_p$, Tm$_e$ ranged from - 5 to 5.7 °C), the highest values of enthalpies (ΔHm ranged from 180.9 to 193.4 J/g; ΔHc about 180 J/g) and the highest crystallisation temperatures (Tc$_o$, Tc$_p$, Tc$_e$ ranged from - 10 to - 15 °C) in comparison to fillings. The sour cherry fillings with guar addition had lower values of all measured thermophysical parameters in comparison with xanthan preparations. Sugar type had also impact on the evaluated properties. The sucrose-based fillings showed lower Tg' values compared to the trehalose systems, which emphasizes the importance of trehalose addition in increasing the stability of the system, particularly in glass transition temperature range.

Keywords: sour cherry fillings, sugars, hydrocolloids, thermophysical properties

HYDRATION PROPERTIES OF GLUTEN-FREE FLOUR MIXTURE MADE FROM RICE FLOUR AND CRICKET (*ACHETA DOMESTICUS*) FLOUR

Agnieszka Orkusz[1,2*], Urszula Kaim[1,2], Joanna Harasym[1,2]

[1]*Adaptive Food Systems Accelerator – Science Centre, Wrocław University of Economics, Poland*
[2]*Department of Biotechnology and Food Analysis, Institute of Chemistry and Food Technology, Wrocław University of Economics, Poland*
[*]corresponding author: agnieszka.orkusz@ue.wroc.pl

poster presentation

The market for gluten-free products is rising as the total number of consumers avoiding wheat/gluten-containing products increases exponentially. Meanwhile, the main problem of gluten-free food is the fact that it is overloaded with structuring agents, the main purpose of which is to create the typical spongy structure from ingredients not containing gluten-protein. The predominant ingredient in a gluten-free formulation is starch, while native flours are few. The more frequently used flour is rice flour, which is rich in starch but its protein level is insufficient.

Edible insects are a good source of protein and can also be perceived as nutritional enrichment in gluten-free formulations. The house cricket (*Acheta domesticus*) protein has been reported by other researchers to be superior compared to soy proteins based on PER.

The main objective of this study was to investigate the water uptake and retention indices in gluten-free flour mixtures composed of rice flour and house cricket flour. Both flours where purchased commercially and six mixtures were prepared to contain 5%, 10%, 15%, 20%, 25%, and 30% of cricket flour, respectively. Water holding capacity, water absorption capacity, water absorption index, water solubility index and swelling power of mixtures were evaluated.

The results revealed a very interesting behaviour of cricket flour. The water holding capacity in cricket flour was almost twice as in rice flour (2.84 g/g d.b. *vs.* 4.04 g/g d.b.), but its impact in the studied mixture was not significantly different. Also, the water absorption index of cricket flour was the highest among the studied samples, while the water absorption index was the lowest, showing different water maintaining behaviour during heating. The water solubility index of rice flour was not impacted by cricket flour addition.

Keywords: gluten-free, edible insects, rice flour, house cricket, *Acheta domesticus*

CHARACTERISATION OF EDIBLE INSECT FLOUR USING INFRARED SPECTROSCOPY

Agnieszka Orkusz[1,2*], Wojciech Sąsiadek[3], Urszula Kaim[1,2], Joanna Harasym[1,2]

[1]Adaptive Food Systems Accelerator – Science Centre, Wrocław University of Economics, Poland
[2]Department of Biotechnology and Food Analysis, Institute of Chemistry and Food Technology, Wrocław University of Economics, Poland
[3]Department of Bioorganic Chemistry, Institute of Chemistry and Food Technology,Wrocław University of Economics, Wrocław, Poland
[*]corresponding author: agnieszka.orkusz@ue.wroc.pl

poster presentation

Edible insects have become the new food raw material and are expanding their presence on the market, while being additionally is extensively promoted by the FAO and recognized by the European Commission under the category of 'Novel foods'. Taking into account the other economies for which the edible insects are not a new product, the predicted future reveales the huge rise in the presence of edible insects on the European market. In South Korea the edible insect market was valued USD 143 million in 2011 and is predicted to reach USD 457 million in 2020.

Being new and of high price ingredients – edible insects – are the potential target of adulteration. Edible insects sold as flour or used as an ingredient enhancing protein content in cereal flour mixtures can be easily adulterated by the addition of other insects, especially typical cereal flour pests. Therefore,it is important to define specific markers for such products i to protect the market from fraud.

The main objective of this study was to investigate the infrared spectra characteristics of three different types of edible insects purchased from the local market. Alphitobius diaperinus (buffalo worms), Tenebrio molitor (mealworms) and Acheta domesticus (house cricket) bought in a form of freeze-dried insects were ground to flour in laboratory mortar with hand pestle and studied using Infra Red-Attenuated Total Reflectance Mid-Infrared (400-4000 cm^{-1}) spectroscopy.

The spectra obtained were superposed against each other and additionally vs the chitin spectrum. The buffalo worm flour and mealworm flour samples revealed high similiarity in the intensity of the characteristic vibrations of the C = O groups at about 1630 cm^{-1}, while the intensinty of cricket sample peaks were about 50% lower compared to the two types of worms. Strong and narrow peaks obtained for samples can serve as markers for the reliable determination of their presence in food products.

Keywords: buffalo worms, mealworms, house cricket, infra-red spectroscopy

ROLLER MILLING OF TWO CROATIAN HULL-LESS BARLEYS AND THE CHARACTERISATION OF FRACTIONS OBTAINED BY THIS PROCESS

Gordana Šimić[1*], Daniela Horvat[1], Marija Kovačević Babić[1], Gjore Nakov[2], Marina Tišma[3], Ana Bucić-Kojić[3], Ana Šušak[3], Alojzije Lalić[1]

[1]Agricultural Institute Osijek, Južno predgrađe 17, 31000 Osijek, Croatia
[2]University of Ruse "Angel Kanchev", Branch Razgrad, Aprilsko vastanie 47, 7200 Razgrad, Bulgaria
[3]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[*]corresponding author: gordana.simic@poljinos.hr

poster presentation

Grain samples of two hull-less barley varieties created at the Agricultural Institute Osijek were roller-milled using Bühler MLU 202 laboratory milling equipment. The mill uses a six-roll system to make refined flour fractions, consisting of three break (B1-B3) and three reduction (C1-C3) passages. Six flour fractions were obtained along with the shorts and bran fractions. Individual fraction milling yields were determined as the proportion (%) of the total products the milling recovered. Six flour fractions were combined to create a straight-run flour (B1+B2+B3+C1+C2+C3) yield, and it varied from 31-34%, with higher yield observed for the Osvit variety. The shorts fraction yield (52%) was higher for the Mandatar than for the Osvit (48%) variety, while there was no difference in the bran fraction yield (16%) determined between these two hull-less barleys. The ash content for white flour fractions ranged from 0.82% to 1.33%, with a noticed decrease in ash content from B1 to B3 and from C1 to C3. The reduction flour streams contained higher protein content than the break flour streams, with bran fractions having the highest protein content (>17%). When comparing straight-run flour streams, the highest starch content was found in the third break B3 flour fractions (81-82%) and the lowest in the second reduction C2 flour fractions (73-75%). Generally, flours derived from break rolls had lower ash, protein, and fat contents, and higher starch content than reduction rolls flours.

Keywords: hull-less barley, milling process, flour fractions characteristics

ENRICHMENT OF PASTA PRODUCTS WITH PLANT AND ANIMAL FATS

Péter Sipos*, Brigitta Horváth, Zoltán Győri

University of Debrecen, 138 Böszörményi street, H-4032 Debrecen, Hungary
*corresponding author: siposp@agr.unideb.hu

poster presentation

Cardiovascular and heart related diseases cause more than one-third of the deaths of the European population under 65 years of age and they show strong correlation to nutrition. The fat consumed is much higher than the recommended value in Hungary and its fatty acid composition does not follow the guidelines. The mono- and polyunsaturated fatty acids have beneficial cardio-protective and anti-tumour effects, but its ratio should be increased in consumption.

The aim of the research was to evaluate the possible replacements for eggs in pasta products with different kinds of plant and animal based fats. In the experiment, we prepared pilot products based on the recipe for pasta containing ten eggs. The recipe included 67% flour, 12% tap water, and 11% fat; the last value was the average lipid content of ten egg pasta. Traditional and industrial drying methods were applied. Aside from the control pasta made with ten eggs, we used cold pressed extra virgin olive oil, cold pressed pumpkin oil, coconut oil, and mangalica and duck fat, and the sensory properties, fatty acid composition, and the acid number of pastas were evaluated and compared.

It was found that there are no significant differences amongst the fatty acid composition of fats and pastas, only the miristic acid content of coconut oil decreased during drying and cooking. The double heat treatment did not influence the trans fatty acid concentration of products. The pumpkin seed and olive oil enriched pasta types got the highest sensory values.

Keywords: pasta products, fatty acid composition, animal fats, plant oils

SENSORY EVALUATION OF GLUTEN-FREE PSEUDOCEREAL BISCUITS

Branka Varešić[1*], Amela Semić[2], Amela Džafić[3], Sanja Oručević Žuljević[3]

[1]Sprind d.d. Rajlovačka cesta bb, 71000 Sarajevo, Bosnia and Herzegovina
[2]AS Holding d.o.o., Ekonomija bb, 74260 Tešanj, Bosnia and Herzegovina
[3]University of Sarajevo Faculty of Agriculture and Food Sciences,
Zmaja od Bosne 8, 71000 Sarajevo, Bosnia and Herzegovina
[*]corresponding author: branka.varesic@sprind.ba

poster presentation

Pseudocereals such as amaranth, buckwheat, and quinoa are nutritious ingredients in gluten-free (GF) formulations due to their high protein quality and abundant quantities of fibre and minerals such as calcium and iron. However, the commercialization of GF products based on pseudocereals is still quite limited and only a small number of such products is available on the market. The aim of this research includes physical and chemical analyses and the sensory evaluation of pseudocereal biscuits (amaranth, buckwheat, and quinoa) produced under laboratory conditions. Biscuit samples made from 100% amaranth (1), buckwheat (2), and quinoa flour (3) were analysed based on chemical (moisture and ash) and physical (weight, diameter, thickness, spread ratio, and volume) quality parameters. Wheat flour (T-500) biscuits (4) were used as control samples. Biscuits were evaluated using QDA, by 37 semi-trained panellists on 4 properties: external appearance (texture and colour), texture perception (hardness, crispness, friability, and melting), aroma (sweet, bitter, green/grassy, and roasted odour), and overall sensory impression. The pseudocereal biscuits significantly differed from the control, except for moisture content. The sensory evaluation of samples revealed that on a 5-point score scale all sensory results were in the range of 2.32 to 4.54, indicating that these biscuits were partly acceptable. The best sensory score among the pseudocereal biscuits was observed in the sample with buckwheat flour (melting 3.78, sweetness 3.41, bitter taste 3.38, green/grassy odour 3, roasted odour 3.38, and overall sensory impression 3.43), while the best texture was exerted by the quinoa sample (3.59), and colour (3.95) and crispness (3.16) were the best for the amaranth sample.

Keywords: biscuits, amaranth, buckwheat, quinoa

DEVELOPMENT OF MATZO MADE OF WHOLEMEAL RYE FLOUR AND ITS IMPLEMENTATION IN THE INDUSTRY

Antal Véha*, Zita Boglárka Zakupszki, Balázs P. Szabó

Department of Food Engineering, Faculty of Engineering, University of Szeged, Szeged, Hungary
*corresponding author: z.zita@mk.u-szeged.hu

poster presentation

Bakery products are one of the most commonly consumed food of the population. One of the major trends in food developing in the baking industry is increasing the fibre content. In our project, we focused on increasing the fibre content in a special bakery product.

The aim of our research was to increase the nutrient content of a matzo made of wholemeal rye flour by boosting the mineral and fibre content. Our goals in the improvement of the product are helping in healthy nutrition and are more economical from production's point of view.

In the first part of our research we performed basic measurements with BL80, BL160, RL90 and RLTK flours to describe their properties. We measured the quantity and quality of gluten protein of wheat flours, and we evaluated the activity of amylase enzymes for all used flours. Finally,we determined physical properties of the investigated flours by a complex dough monitoring. The results indicated that each flour is applicable for matzo production.

In the second part of our project we compared the basic product with three matzos made of diverse recipes which contain different percentages of rye and wheat flours. We evaulated the ash content, the acid content and fibre content of the products. Finally, we made an organoleptic measurement and an economic calculation.

Based on the results of experiments it can be ascertained that the new product shows more auspicious values of the fibre content and prime costs are lowered too.

Keywords: trend, development, fibre content, rye flour, matzo

BREAD-MAKING PERFORMANCE OF COMMERCIAL DURUM WHEAT BY-PRODUCTS

Abdenour Yesli[1*], Samia Lefkir[2], Zakia Abdellaoui[3], Ghania Ounane[4]

[1]Ecole Supérieure des Sciences de l'Aliment & des Industries Agro-Alimentaires, Route de Beaulieu, El Harrach 16200, Algers, Algeria
[2]Université M'Hamed Bougara, Boumerdes, Algeria
[3]Université Saad Dahlab, Blida, Algeria
[4]Ecole Nationale Supérieure Agronomique (ENSA), Hassen Badi, El Harrach 16200, Algiers, Algeria
[*]corresponding author: yesliabd@yahoo.fr

poster presentation

The baking quality of by-products obtained from Algerian durum wheat and the possibility of their use in bread-making were investigated in this study. Analyses were done with samples of durum wheat collected at a mill. The samples were by-products or durum wheat flours from the first break roller (F1), the fourth break roller (F4), and the final durum flour product (DF). Significant differences between flours (p<0.05) were revealed on physicochemical, rheological and pasting properties. The bread made with flour from the first break roller had significantly higher quality than the products made with flour from the fourth break roller and the final durum flour product. The obtained results show that bread quality can be predicted by the content of the gluten index, mixing dough tolerance and the particle size index.

Keywords: bread, gluten index, starch damage, unextractable polymeric protein

CEREALS AND CLIMATE CHANGES

THE EFFECT OF CLIMATE CHANGE ON CEREAL GRAIN QUALITY

Dragan Živančev[1*], Jasna Mastilović[2], Aleksandra Torbica[2], Daliborka Koceva Komlenić[3]

[1]Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21101 Novi Sad, Serbia
[2]University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
[3]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[*]corresponding author: dragan.zivancev@ifvcns.ns.ac.rs

invited lecture

One of the toughest tasks of the 21st century is to solve the difficulties caused by global climate change. Alternating dry and rainy years, long periods with extremely high temperatures, and increased mean temperatures worldwide have substantial negative effects on agricultural production. The most important cereal food in the world is cereal grain. The functional cereal grain quality defines their purpose in the food industry for particular end-use products. Aside from genetic heritage and post-harvest storing, cereal grain quality also depends on the environment conditions. Wheat, along with corn and rice, is the world's most widely used cereal. Therefore, this lecture presents research results from several different surveys about the influence of climatic changes on the wheat quality. The results showed that the season with the high average temperature could cause decreased protein content, wet gluten content, farinograph water absorption, Alveograph W, and bread volume, but an increase in amilograph peak viscosity, in the period from wheat anthesis to the full ripening grain. Also, a high temperature during June could cause the rheological properties of wheat cultivars with the HMW-GS composition 2*, 5 + 10, 7 + 9 to be at the similar level as those of cultivars with the HMW-GS composition -, 2 + 12, 7 + 9 produced in the season with lower temperature. It could be concluded that wheat quality in most surveys is mainly influenced by the production conditions.

Keywords: climate change, cereal, wheat, grain quality

IMPACT OF HIGH TEMPERATURE ON THE ACCUMULATION OF PROLINE IN GENETICALLY DIVERGENT CEREAL VARIETIES

Stefan Marković[1], Nevena Djukić[1*], Aleksandra Torbica[2], Dragan Živančev[3], Simin Hagh Nazari[4]

[1]University of Kragujevac, Faculty of Science, Radoja Domanovića 12, 34000 Kragujevac, Serbia.
[2]University of Novi Sad, Institute for food technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
[3]Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia
[4]Department Food Science and Technology, Faculty of Agriculture, University of Zanjan, Zanjan, Iran
[*]corresponding author: nevena@kg.ac.rs

poster presentation

Growth and development of cereals is affected by abiotic factors, particularly by high temperature. An important factor in plant adaptation to abiotic stress can be the proline accumulation. Proline is an amino acid involved in a series of metabolic processes and is important as a protein stabilizer, osmolite and antioxidant. Under normal physiological conditions, the proline makes up less than 5% of the free amino acids in the plant, while due to stress this amount can increase to over 80%.
Field experiment was conducted with the aim to determine the effect of high temperature on the proline content in different cereal varieties during two vegetative seasons. For the investigation, plant material of 8 genetically divergent winter wheat varieties, 1 variety of triticale and 1 oat variety were used. Samples were collected in days with moderate midday air temperatures of 24-26 °C in the milk stage and after a few days in the same phenological stage, in conditions of high midday air temperatures of 34-36 °C.
The results from both seasons showed that under moderate air temperatures the mean proline content was 0.719 µmol g^{-1} of fresh plant, while under heat stress conditions the mean proline content increased to 2.339 µmol g^{-1} of fresh plant. Compared with other cereal varieties, wheat varieties Zvezdana, Pobeda, Simonida and Avenu were characterized by higher contents of proline in conditions of heat stress in both vegetative seasons. The obtained results showed that the content of proline in cereals can be thermally induced.

Keywords: proline, cereals, heat stress

PROTEIN AND PHENOLIC PROFILES OF WHEAT FLOUR AND THEIR RELATION TO THE RHEOLOGICAL BEHAVIOUR OF DOUGH

Marijana Simić[1*], Slađana Žilić[1], Dejan Dodig[1], Vuk Maksimović[2]

[1]*Maize Research Institute, Slobodana Bajića 1, Zemun Polje, Belgrade, Serbia*
[2]*Institute for Multidisciplinary Research, University of Belgrade, Belgrade, Serbia*
[*]corresponding author: marijana.simic@mrizp.rs

poster presentation

The present study was aimed at determining the effect of environment on protein and phenolic profiles of five bread wheat flours, as well as the influence of these traits on the rheological behaviour of dough. Trials were conducted in two successive years under contrasting moisture conditions during spring growing season. The proteins were separated into four fractions and evaluated by SDS-PAGE. The concentration of total cysteine, free sulfhydryl groups and disulfide bonds was measured, as well as total phenols, flavonoids and phenolic acid. The rheological properties of dough were determined by farinograph and extensograph.

Environmental conditions influenced the total phenolic and ferulic acid content, and it was significantly higher in flours produced in year 2017 that those in 2016 by, in average, 20% and 64%, respectively. The higher content of ferulic acid slightly increased the dough stability, but had no influence on dough breakdown. Environmental conditions during growing season 2016, although decreased the content of albumin and globulin fractions, resulted in wheat flour with higher total protein, gliadin, as well as glutenin content that positively influenced the mixing tolerance and dough extensibility. The extensibility of dough prepared from flours of two winter wheat genotypes ZP 87/1 and ZP Zemunska rosa was 164 mm and 137 mm in year 2016, and 91 mm and 73 mm in year 2017, respectively. A-group of HMW-glutenin contributing 15.15% and 12.95% of total extractable proteins in flour of genotypes ZP 87/1 and ZP Zemunska rosa produced in year 2016, respectively, had a crucial effect on dough extensibility.

Keywords: wheat flour, proteins, phenolics, rheology of dough

CEREALS AND HEALTH

NUTRITIVE AND HEALTH ASPECTS OF CEREAL-BASED SNACK PRODUCTS

Daniela Čačić Kenjerić*

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, Osijek, Croatia
*correspondence: daniela.kenjeric@ptfos.hr

invited lecture

In most adult populations, cereals are a primary staple food, while in infants they present the primary choice for weaning foods. They are a major source of energy and an important contributor to starchy carbohydrate and dietary fibre intake. They also contribute substantially to the protein intake as well as vitamin B, iron, zinc, and calcium intake. Due to all these contributions, cereals and cereal-based foods are generally considered as a healthy food choice. Snack products, on the other hand, are generally considered as unhealthy, while snacking contributes with almost one-third to the total daily energy intake via "empty calories". Cereal-based snack products (CBSP) combine advantages of cereals as a staple food and the disadvantages of snacking as a habit, and therefore can be considered health promotors as well as risk factors for certain diseases at the same time.
The aim of this lecture is to present the range of CBSP benefits and risks, with the focus on overall energy and nutrient intake, nutrient insufficiencies and excesses, and cardiometabolic health.

Keywords: cereal based snack products (CBSP), dietary intake, benefits, risks

INTERACTIONS BETWEEN β-GLUCAN FROM CEREALS AND POLYPHENOLS

Lidija Jakobek[1*], Andrew R. Barron[2]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[2]Yale University, Department of Statistics and Data Science, 24 Hillhouse Avenue, New Haven, CT 06511, USA
[*]corresponding author: lidija.jakobek@ptfos.hr

invited lecture

Polyphenolic compounds have shown many beneficial effects. Their bioaccessibility, or the amount that can be accessible for absorption in the digestive tract, is important for these effects. The bioaccessibility of polyphenols can be affected by dietary fibers. Namely, dietary fibers are resistant to digestion and absorption in the human small intestine and they can be fermented partially or completely in the large intestine. That is why they have the potential to interact with polyphenols in the digestive tract, to "carry" them unchanged to the lower parts of the digestive tract and by that affect their bioaccessibility. β-glucan is a dietary fiber that can be found in cereals such as barley and oats. Studies have shown that it can interact with polyphenols. Those interactions are affected by the pH value of the environment, the ionic strength, and temperature. To study these processes *in vitro*, the adsorption processes between β-glucan and polyphenols can be investigated. The aim is to describe the interactions between β-glucan from cereals and polyphenols, the role of the adsorption processes in the explanation of these interactions, and to explain the role of statistical modeling of experimental data in the adsorption process.

Keywords: bioaccessibility, adsorption, adsorption isotherms, statistical fitting

ARE THE "GLUTEN FREE" PRODUCTS REALLY GLUTEN FREE?

Lea Pollak*, Andrea Adanić Pajić

Croatian National Institute of Public Health, Rockefeller str. 7, 10000 Zagreb, Croatia
*corresponding author: lea.pollak@hzjz.hr

invited lecture

The trend of the development and use of gluten-free products is increasing. Consumption of gluten free food for some people is a cure, but for some healthy people it has become a way of life.
Celiac disease is a gastrointestinal disease caused by the persistent intolerance of gluten protein, found in wheat, rye, barley and oats. Other cereals, such as maize, amaranth, quinoa or rice, do not contain prolamine fractions which are toxic for gluten intolerant celiac patients, and are therefore suitable for their diet.
Regulation (EU) No 1169/2011 on the provision of food information to consumers, did not prescribe the amount of gluten on a label, only gluten as an allergen is compulsory.
However, previous Commission Regulation (EC) No. 41/2009 on the composition and labelling of foodstuffs suitable for gluten-intolerant persons and new Regulation 828/2014 on the requirements for the provision of information to consumers on the absence or reduced presence of gluten in food prescribes the following terms: "Gluten free" and "Very low gluten content" as well as "Suitable for people intolerant to gluten" or "Suitable for people with celiac disease". All of these claims are linked to the amount of gluten in the product obtained analytically, and depends on the product ingredients. The terms of reference for food for general consumption and forbidden use are covered.
In the Croatian Institute of Public Health researching of gluten in gluten-free products started in 2003. That was repeated periodically, while a new survey was conducted during 2018.
The lecture will give an overview of the results of research of non-gluten products during several years of researching.

Keywords: gluten-free products, gluten, gluten labelling, research

β-GLUCAN FROM BARLEY AS AN ADSORBENT OF QUERCETIN

Jozo Ištuk*, Lidija Jakobek

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
*corresponding author: jozo.istuk@ptfos.hr

oral presentation

β-glucan is a dietary fiber present in cereals like barley and oats. It has shown many positive bioactivities in the human organism. One of positive effects of dietary fibers in general, and β-glucan in particular, is their interaction with polyphenols, a group of secondary plant metabolites, commonly present in human nutrition. Namely, β-glucan has the potential to bind polyphenols, protect them from the degradation, and transfer them to the lower parts of the digestive tract, which may affect bioactivities of polyphenols. Interactions between polyphenols and β-glucan can be analysed by studying the adsorption process in which β-glucan serves as an adsorbent. The aim of this study was to investigate the adsorption of a quercetin derivatives (quercetin-3-glucoside, quercetin-3-galactoside and quercetin-3-rhamnoside) as a group of polyphenols, onto β-glucan from barley as an adsorbent, at three different temperatures: 25 °C, 37 °C and 45 °C. The concentration of nonadsorbed derivatives of quercetin after equilibration was determined by the spectrophotometric Folin-Ciocalteu method (c_e, mol L^{-1}), and the adsorption capacity (q_e, mol g^{-1}) was calculated. Experimental data (c_e and q_e) were modeled with the equations of three different adsorption isotherms (Freundlich, Langmuir, and Dubini-Radushkevich) by using nonlinear regression. It has been shown that β-glucan can be an efficient adsorbent of quercetin derivatives, and that the temperature and glycosylation affect adsorption process. Namely, quercetin derivatives showed different adsorption capacity at different temperatures. Further studies about the influence of other parameters on the adsorption of quercetin derivatives (pH value, ionic strength, kinetic studies) are required.

Keywords: β-glucan, barley, polyphenols, adsorption

GLYCAEMIC INDEX OF BREAD

Dubravka Novotni*

Faculty of Food Technology and Biotechnology, University of Zagreb, Pierottijeva 6, 10000 Zagreb, Croatia
*corresponding author: dnovotni2@pbf.hr

workshop lecture

Glycaemic index (GI) is a tool for the classification of carbohydrate foods according to postprandial glycaemia. Carbohydrate foods that increase blood glucose rapidly are known as high GI foods (≥70), the opposite to low GI foods (≤55) that increase blood glucose gradually. Typical bread contains high amounts of carbohydrates, but its GI value can range from 40 to 97. The differences in bread GI can be due to the molecular configuration of starch, the degree of starch gelatinization depending on processing methods, the crumb structure in terms of compactness and viscosity, the interactions with other components, such as protein and lipids, as well as the presence and type of dietary fibre and organic acids. Therefore, the GI of bread can be manipulated by the choice of ingredients, as well as by processing conditions. Aside from the GI, the overall glycaemic response is also influenced by the quantity of consumed carbohydrates, which can be described by the glycaemic load (GL). There is a scientific consensus that diets low in GI and GL are relevant to the prevention and management of diabetes and coronary heart disease, and probably obesity. Yet, an EFSA panel (2010) concluded that a cause and effect relationship has not been established between the consumption of carbohydrates that induce a low/reduced glycaemic response or carbohydrates with a low GI and the claimed effects. Therefore, diets low in GI and GL should always be considered in the context of healthy diets containing whole grains.

Keywords: bread, glycaemic index, glycaemic load, whole grains, diabetes

GLYCAEMIC INDEX THROUGH THE EYES OF CONSUMERS

Martina Pavlić*

Croatian Agency for Agriculture and Food, Vinkovačka cesta 63c, 31000 Osijek, Croatia
*corresponding author: martina.pavlic@hapih.hr

workshop lecture

The concept of the glycaemic index (GI) was introduced in order to rank foods on the basis of the glycaemic response in the blood after the consumption of carbohydrate-containing foods. The purpose of developing this index was primarily to make the control of postprandial glycaemia in people with diabetes easier. Cereal food is usually considered high GI food due to its easily available carbohydrate content. Today, high GI food is associated with the increased risk of diabetes, metabolic syndrome, cardiovascular disease, and cancer, therefore, there is a higher interest in GI values of different foods on the market. The purpose of labelling food and food products with the GI mark is to increase consumer awareness and to assist in the selection and purchase of food. Over the past decade, the GI concept has been applied to labelling in a number of countries around the world. The labelling of the GI value on the product declaration increases its value, but is not mandatory in Croatia. In order to put such information on the declaration, producers must receive support from the competent institutions, which can implement such labelling and provide education for consumers. The introduction of GI labels on product declarations is something to be considered in the long run.

Keywords: glycaemic index, cereal products, labelling, consumer perception

FEATURES OF HEAVY METAL ACCUMULATION BY DIFFERENT VARIETIES OF BUCKWHEAT GROATS AND MILLET CEREALS

Antonina Dubinina, Tetiana Popova, Svitlana Lenert, Inna Byelyayeva*, Valeriia Hershun

Kharkiv State University of Food Technology and Trade, Klochkivska str. 333, Kharkiv, Ukraine
*corresponding author: tovaroved206@ukr.net

poster presentation

Among the large assortment of cereals, buckwheat and millet are in great demand. Buckwheat and millet have high nutritional and consumer value. Due to their unique chemical composition, they are considered to be a universal component of a healthy diet, widely used in various sectors of the food industry. However, in addition to nutrients, they may contain harmful compounds which can exhibit toxic effects.

The intensive development of industrial sectors leads to environmental pollution caused by chemicals. The most dangerous are the heavy metals that do not decompose in the environment and accumulate in the tissues of living organisms. Penetrating into the plants, they negatively affect the metabolic processes, which leads to a decrease in yield and the threat of contamination by heavy metals in food, and this already constitutes a danger to human health.

One of the factors influencing the ability to accumulate heavy metals is the variety of species and plants. Therefore, the study of the peculiarities of the accumulation of these toxicants in buckwheat groats and wheat, depending on the variety of cultivars, is relevant and of practical importance for ensuring the nutritional harmlessness of the cereal raw material.

In the course of the study, the content of heavy metals was determined in grains from buckwheat of six varieties and millet of five varieties most common in the Ukraine.

Varieties of buckwheat and millet which have the ability to accumulate the least heavy metals have been identified. These varieties are recommended for the production of healthy products.

Keywords: buckwheat, millet, heavy metals, toxicity, boundary permissible concentration

COMPARISON OF THE β-GLUCAN CONTENT IN DIFFERENT BARLEY GENOTYPES

Nevena Djukić[1*], Stefan Marković[1], Dragan Živančev[2], Aleksandra Torbica[3], Simin Hagh Nazari[4]

[1]University of Kragujevac, Faculty of Science, Radoja Domanovića 12, 34000 Kragujevac, Serbia
[2]Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia
[3]University of Novi Sad, Institute for food technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia
[4]Department Food Science and Technology, Faculty of Agriculture, University of Zanjan, Zanjan, Iran
[*]corresponding author: nevena@kg.ac.rs

poster presentation

Among cereals, the largest amount of β-glucan is contained in oat and barley. The content of β-glucan varies from 2.5% to 11.3% in the whole barley seed. β-glucans have a number of positive effects on human health and a wide range of potential applications in the food and pharmaceutical industry.

The aim of our research was to analyze the variability of β-glucan content in ten varieties of barley. For determining the content of β-glucan ICC Standard method No. 168 was used.

Based on the identified variability of β-glucan content, a similarity between barley varieties was established and was shown by dendrogram. Three clusters of similar varieties were noticed. Within the Cluster 1 with the highest content of β-glucan, there are two varieties - Oplenac (7.08%) and Pek (6.93%) with a degree of similarity 91. This pair shows the distance from the other cluster of 35, and is in relation to the third cluster 51. The other cluster consists of four varieties (the distance between them is 12 to 18), with a slightly lower concentration of β-glucan: Orion (6.35%), Jastrebac (6.06%), Dinarac (5.80%) and Kraguj (5.65%). In the third cluster, varieties with the largest distance from the previous two clusters are grouped: Novosadski 488, Profit, Dunavac and Midžor, with a concentration of β-glucan less than 5%.

The results indicate a genetic divergence in β-glucan content between the investigated genotypes and the ability to select the appropriate barley genotypes for breeding programmes.

Keywords: β-glucan, barley, genotypes

PROTEIN REMOVAL FROM OAT BETA-GLUCAN HIGH PURITY FRACTIONS

Katarzyna Dziendzikowska[1*], Ewa Żyła[1], Joanna Harasym[2,3], Joanna Gromadzka-Ostrowska[1]

[1]Department of Dietetics, Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences
[2]Adaptive Food Systems Accelerator – Research Centre, Wrocław University of Economics, Poland
[3]Department of Biotechnology and Food Analysis, Institute of Chemistry and Food Technology, Wrocław University of Economics, Poland
[*]corresponding author: k.dziendzikowska@gmail.com

poster presentation

1-3, 1-4 -beta-D-glucan fraction from oat in a highly concentrated form (>50 %) is obtained using, as crucial, any type of extraction (fat with supercritical CO2, starch with enzymatic digestion). The oat beta-glucan isolation method mainly differs in the type of grain fraction used as raw material, the solid-liquid ratio of beta-glucan content in raw material vs solvent used, and the type of solvent (supercritical CO2, alkali, water, or acidic). Such diversification has an impact on the characterization of residuals, which are finally found in oat beta-glucan extracts. Oat bran, as a rich source of the globulin fraction, can provide problems with protein contamination of concentrated beta-glucan fractions. Therefore, the multi-stage (enzymatic and acidic) purification procedure was implemented to remove the residuals, especially starch and protein, from oat-beta glucan isolates of different molar mass. The starch hydrolysis and liquefaction significantly facilitate the proteinaceous matter removal, although papain usage showed the intensive detrimental impact on beta-glucan molar mass. Soluble protein content was decreased just after pancreatin and alpha-amylase treatment, while the significant reduction of amine nitrogen was noted after complete starch hydrolysis and the second acidification step. The complex procedure employing different enzymes is needed to successfully diminish the possible important residuals in oat beta-glucan isolated fractions. The highly purified oat beta-glucan can be further applied as a food ingredient and a study based on a dose-dependent scheme won't be biased by the impact of other bioactive components of oat, especially proteins and peptides.

Keywords: oat beta-glucan, wet isolation method, alkali treatment, papain, pancreatin, proteinaceous residuals

Acknowledgement:
The work was conducted under the financial support of Narodowe Centrum Nauki, Poland, through the grant UMO-2018/29/B/NZ9/01060.

BUCKWHEAT *(FAGOPYRUM ESCULENTUM* (MOENCH)), AMARANTH *(AMARANTHUS* SPP.) AND QUINOA *(CHENOPODIUM QUINOA* (WILD)) IN BAKERY PRODUCTS

Szintia Jevcsák[1*], Gerda Diósi[1], Péter Sipos[2]

[1]University of Debrecen, Kálmán Kerpely Doctoral School, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Food Technology, Böszörményi str. 138, H-4032 Debrecen, Hungary
[2]University of Debrecen, Institute of Nutrition, Böszörményi str. 138, H-4032 Debrecen, Hungary
[*]corresponding author: jevcsak@agr.unideb.hu

poster presentation

Buckwheat, amaranth, and quinoa are popular plants of the group of pseudocereals. Nowadays, their consumption is increasing due to their adaptive traits in different environment conditions (Taylor and Awika, 2017). They can be utilized as a source for new developments in food processing. The aim of this study was to produce muffins from pseudocereal flours, with natural additional ingredients and additives and to measure different parameters of the products. The research was based on Codex Alimentarius Hungaricus: "Bakery products with distinctive quality indication". Products were prepared using different pseudocereal (gluten free) flours or their combination. Measured parameters were: baking loss, the volume of products by rapeseed displacement (AACC International, 2000; Method 10-05.01) and organoleptic examination by questionnaire.
Pseudocereals has been found to be good material for bakery products. Measurements confirmed that produced muffins have good quality.

Keywords: bakery product, pseudocereals, utilization, quality

Acknowledgements:
Supported By The Únkp-18-3 New National Excellence Program Of The Ministry Of Human Capacities.

EVALUATION OF THE EFFECTS OF VITAMIN AND MINERAL FORTIFIED BREAD ON SOME BLOOD PARAMETERS OF CHILDREN, ADULT AND OVERWEIGHT DIABETIC SUBJECTS

Tülay Kahraman Genç*

Unmaş Unlu Mamüller Sanayi Ve Ticaret A.Ş., Research and Development Center, Istanbul, Turkey
*corresponding author: tulay.kahraman@uno.com.tr

poster presentation

Today, micronutrient deficiency is known to be the most important problem of about one third of the world population. It affects both mental, physical and productivity of the population and lowers the quality of life directly. This problem is also present in Turkey, particularly within its vulnerable groups. In most of the developed countries this problem is dealt with the fortification of foods with micronutrients. The application of fortification in our country is far from solving the micronutrient deficiency problems. However, fortification of staple foods such as bread is accelerated in the recent years. In this context, this clinical research project is planned in order to determine the bioavailability of bread fortified with B vitamin groups, iron, zinc and calcium. In the study, feeding experiment was carried out on 3 different groups (adult group, *n*=29; fitness diet group, *n*=28 and 4-10 years of age children group, *n*=21 with controls). Socio-demographic, anthropometric, dietary history and food consumption patterns were recorded. Blood samples were taken for the analyses of hemogram, blood lipids, fasting blood sugar, urea, alkaline phosphatase, total antioxidants, vitamins B_1, B_2, B_6, B_{12}, folic acid, niacin and iron, zinc, calcium minerals, both at the beginning and end of the feeding applications. All of the results were evaluated by the statistical analysis programme. The bioavailability of fortified bread was determined and the correlation of some parameters was recorded and evaluated. At the end of the study significant increases were found in the blood vitamin and mineral levels.

Keywords: fortification, B vitamins, minerals, bread, blood analyses

IMPORTANT NUTRITIONAL INGEDIENTS OF GLUTEN-FREE BREAD WITH PSEUDOCEREALS

Urszula Kaim[1,2*], Joanna Harasym[1,2], Agnieszka Orkusz[1]

[1]Adaptive Food Systems Accelerator – Science Centre, Wrocław University of Economics, Poland
[2]Department of Biotechnology and Food Analysis, Institute of Chemistry and Food Technology, Wrocław University of Economics, Poland
[*]corresponding author: urszula.kaim@ue.wroc.pl

poster presentation

Typical Western diet is changing because of the rising number of patients suffering from wheat and gluten-related disorders and gluten-free lifestyle. Gluten-free diet, recommended for medical reasons, is the only effective treatment increasing from year to year in a number of patients. Unfortunately, most of the gluten-free products available on the market, especially bread, lack the nutrients and quality in comparison to their original equivalents. This is caused by manufacturing methods of such gluten-free products, which include mainly highly purified ingredients like starch and hydrocolloids. The viable alternative for the existing gluten-free products are naturally gluten-free raw materials containingpseudocereals, naturally free of gluten, which can be extremely nutritious food. Their chemical content, high level of nutritious fractions, especially fibre and antioxidants, make these plants human food and wheat substitutes.

Pseudocereal flours can be used for the enrichment of gluten-free formulations with proteins and bioactive compounds, such as antioxidants, and to achieve optimal lipid profile, with a potentially significant impact on the consumer's health. Although pseudocereals can be found at any latitude and contain lots of micro and macro elements, starch, proteins and fibers, they are still underestimated in their application, especially in food manufacturing.

The aim of the presentation is to compare the chemical characteristics and the baking proprieties of pseudocereals such as buckwheat, amaranth, chia, quinoa, and kaniwa, used in the bread formulation.

Keywords: gluten-free, pseudocereals, bread formulations, nutrients, bioactive compounds

WHEAT AND GLUTEN RELATED DISORDERS

Urszula Kaim[1,2*], Joanna Harasym[1,2], Agnieszka Orkusz[1]

[1]Department of Biotechnology and Food Analysis, Institute of Chemistry and Food Technology, Wroclaw University of Economics, Wrocław, Poland
[2]Adaptive Food Systems Accelerator – Science Centre, Wroclaw University of Economics, Poland Wrocław, Poland
[*]corresponding author: urszula.kaim@ue.wroc.pl

poster presentation

In the last few decades, the number of patients suffering from wheat related disorders is constantly rising. Numerous different disorders and diseases are being diagnosed, and their occurrence is easily correlated with the duration of exposure time for wheat or gluten. The spectrum of wheat and gluten-related disorders is large, extensive, and increasing. Medical cases are mainly attributed to allergic/ inflammatory reactions to cereal proteins (primarily gliadins, secalins, and hordeins). Otherwise, as a result of exclusion, disorder symptoms are assigned to other existing compounds, especially in wheat. Converging and accruing evidence suggests that the wheat/gluten-mediated immune response can be associated with neurological and psychiatric manifestations. On the other hand, gluten sensitivity disorders, such as non-celiac gluten sensitivity, represent an exclusive condition with a theoretically different mechanism and different manifestations than celiac disease. The effects on the functioning of the central nervous system caused by wheat/gluten consumption are particularly not negligible for a large number of patients, as described in medical literature. That is why the correct diagnosis is so important, unfortunately a huge number of patients suffering from wheat or/and gluten intolerance is still undiagnosed and untreated.
Still, the only recommended treatment for such patients is the eliminatory diet, requiring the removal of all wheat or/and gluten-containing products from the environment or/and diet. The presented study is the extensive literature state-of-art study. The conclusions have been placed upon a focused literature review, based on 63 literature positions analysed in a period of 25 years (1994 – 2019).

Keywords: wheat related disorders, gluten related disorders, immune, neurological, psychiatric

OCCUPATIONAL EXPOSURE OF FARMERS AND FOOD PROCESSING WORKERS TO FUNGI AND MYCOTOXINS

Ante Lončarić[1*], Tihomir Kovač[1], Biljana Crevar[1], Bojan Šarkanj[2]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia
[2]Universty North, Department of Food Technology, Trg dr. Žarka Dolinara 1, 48000 Koprivnica
[*]corresponding author: ante.loncaric@ptfos.hr

poster presentation

Fungi are unavoidable food contaminants which are present in all stages of food processing, form field to fork. Cereals represent a primary source of fungi in our food, as well as the source of occupational exposure to fungi. Farm workers, workers in elevators, silos, and mills are often highly exposed to fungi, and in cases of decreased immunity they can develop different types of mycoses. In this survey, we have analysed the air, dust, and cereals in five different silos and five farms, and based on the results, the estimated the risk of developing mycoses in workers. The presence of *Aspergillus* spp., *Alternaria* spp., *Fusarium* spp., and *Penicillium* spp., known mycotoxin producers, was detected in all of the test samples in all locations. Due to exposure to *Aspergillus* spp. a well-known cause of Pulmonary aspergillosis, it was recommended that workers wear at least face masks and regularly change their workplace form within the building to the outside, in order to reduce the burden of Aspergilli on lungs, combined with regular annual health examinations.

Keywords: foodborne fungi, mycotoxins, food safety, occupational toxicology

MINERAL ELEMENTS IN WHEATGRASS JUICE

Sanja Grubišić, Marija Kristić, Miroslav Lisjak, Sonja Petrović, Zdenko Lončarić, Andrijana Rebekić*

Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, 31000 Osijek, Croatia

*corresponding author: arebekic@fazos.hr

poster presentation

Aside from its usage as a staple food, wheat could be used as a dietary supplement as well. Wheatgrass consists of young shoots of wheat that are rich in chlorophyll, bioflavonoids, essential amino acids, vitamins, minerals, and antioxidants. Due to its chemical composition, wheatgrass has numerous positive effects on human health, such as the detoxification of the organism, the strengthening of the immune system, the improvement of blood test results, and others. In this study, forty winter wheat genotypes (23 Croatian, 8 Hungarian, and 9 Serbian) were investigated for total Ca, Mg, Fe, Mn, and Zn concentrations in fresh wheatgrass juice (WGJ) and their *in vitro* bioaccessibility. *In vitro* digestion was conducted according to Kiers et al. (2001). Total and bioaccessible concentrations of minerals were determined by the ICP-OES technique. The mean values of total mineral concentrations in WGJ varied from 249 to 533 mg L^{-1} Ca, 156 to 272 mg L^{-1} Mg, 2.26 to 5.16 mg L^{-1} Fe, 2.78 to 4.45 mg L^{-1} Mn, and 1.54 to 2.98 mg L^{-1} Zn. The percentages of bioaccessibility calculated on the basis of total and *in vitro* bioaccessible concentrations were as follows: 86% Mg, 84% Mn, 77% Ca, 40% Fe, and 32% Zn. The investigated wheat genotypes differ in total Ca (p<0.01), Mg (p<0.01), Mn (p<0.01), Fe (p<0.01), and Zn (p<0.01) concentrations in WGJ, while significant differences in the % of bioaccessibility between genotypes were found only for Fe (p<0.01) and Zn (p<0.01). The obtained results indicate that the introduction of fresh WGJ into our nutrition could significantly increase the daily intake of essential minerals, especially Ca and Mg.

Keywords: mineral malnutrition, functional food, nutraceuticals, wheatgrass, biofortification

CEREAL PRODUCTS CONSUMPTION FREQUENCY IN RELATION TO ANTHROPOMETRIC AND BIOCHEMICAL PARAMETERS IN HOSPITALIZED SCHIZOPHRENIC PATIENTS

Tamara Sorić[1], Mladen Mavar[1], Ivana Rumbak[2*]

[1]Psychiatric hospital Ugljan, Otočkih dragovoljaca 42, 23275 Ugljan, Croatia
[2]University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, 10000 Zagreb, Croatia
[*]corresponding author: ivana.rumbak@pbf.hr

poster presentation

Cereal products (CP) are important components of human nutrition. Whole grains and refined cereals differ in their structural properties and physiological effects. Inadequate dietary habits, as a characteristic of schizophrenic patients, may affect life expectancy and disease complications. This study is aimed at assessing the CP consumption frequency and at determining its association with anthropometric and biochemical parameters of hospitalized schizophrenic patients. The intake of selected CP (wheat/mixed-wheat bread, rye/whole-wheat bread, pastries, breakfast cereals, pasta, rice) was assessed in 259 subjects (aged 18-67) using the nutrition section of Dlugosch & Krieger's General Health Behaviour Questionnaire. Body weight and height, waist and hip circumferences, % body fat, and blood pressure were measured. Serum triglycerides, total cholesterol, HDL-cholesterol, and glucose were determined from blood samples. LDL-cholesterol was calculated using the Fiedewald formula. Daily consumption of wheat/mixed-wheat bread was reported by 208 participants (80.3%), whereas only 6 participants (2.3%) consumed rye/whole-wheat bread equally often. Pastries were eaten few times a week by 87 participants (33.6%). Rye/whole-wheat bread was consumed less frequently among the participants with triglycerides (p=0.014), total cholesterol (p=0.006), and LDL-cholesterol (p=0.003) in the normal range, while rice was consumed more frequently among those with glucose (p=0.041) and total cholesterol (p=0.021) in the normal range. No association was found between other selected CP and the studied anthropometric and biochemical parameters. The results indicated that the impact of CP, as an isolated food group, on the observed anthropometric and biochemical parameters was obviously not dominant. Certain inadequacies in CP consumption pointed out a need for proper nutrition education of schizophrenic patients, as well as for prospective studies that would elucidate the impact of CP on anthropometric and biochemical parameters.

Keywords: cereal products, cardiovascular risk, schizophrenia

EFFECTS OF CEREAL CONSUMPTION ON GUT MICROBIOTA COMPOSITION

Ivana Rumora Samarin*, Ivona Grilec, Ana Samodol, Valentina Bačić, Ines Panjkota Krbavčić, Damir Oros, Antonio Starčević, Jurica Žučko

University of Zagreb, Faculty of Food Technology and Biotechnology, Department of Food Quality Control, Pierottieva 6, 10000 Zagreb, Croatia
*corresponding author: irumora@pbf.hr

poster presentation

The intake of whole cereal grains has long been linked to decreased risks of metabolic syndrome, cardiovascular diseases, and diabetes type II. It is believed that a complex range of components in whole grain cereals creates a synergistic action resulting in protective effects. Some of those components, such as resistant starches and arabinoxylans, which are not digested in the upper gastrointestinal tract, serve as a food source for gut microbiota. Generally, it is believed a diet rich in whole grain cereals (fibres) is good for the microbiota, as it increases diversity and specifically increases bacterial genera believed to be beneficial, such as Bifidobacterium and Lactobacillus. In this study, the intake of cereals was assessed using the 3-day food dietary method among the *MicroEquilibrium* study cohort, consisting of 40 subjects, both males and females, average age 27.75 ± 0.66, distributed according to their degree of body mass index (underweight, healthy, and overweight/obese). The composition of microbiota was determined by sequencing the V3-V4 region of the 16S rRNA gene, and the taxonomic composition and alpha diversity of the subjects were correlated with the individual cereal intake. The results showed an increase in gut microbiota diversity in subjects with higher whole grain cereal intake.

Keywords: diet, cereal intake, fibre, gut microbiota

POSSIBLE APPLICATIONS OF BREWER'S SPENT GRAIN IN PRODUCTION OF BREAD AND PASTRY

Goran Saric*

Karlovac University of Applied Sciences, Trg J.J.Strossmayera 9, 47000 Karlovac, Croatia
*corresponding author: gsaric@vuka.hr

poster presentation

Brewer's spent grain (BSG) represents up to 85% of the total residue from the brewing process (approximately 20 kg/hl of beer), and if including wastewater, it is the second largest by-product in brewing industry. It is usually used as landfill and animal feed, but as many breweries are situated in urban areas, they often have problems in getting rid of this by-product. Having in mind that approximately 3.4 million tons of BSG is produced in the European Union annually, it is important to consider other applications of this interesting raw material. A lot of research has been done on investigating different possibilities of incorporating cereal by-products as functional ingredients of various foods, including breads, cereal bars, extrudates and pasta. Brewer's spent grain has very good nutritional properties, not only for livestock, but also for humans. It is lignocellulose material rich in hemicellulose, proteins, cellulose, lipids and lignin, but can also be characterized as a good source of phenolic compounds and some minerals. Considering that, it has a great potential to be used as a good source of dietary fibres in human nutrition. When dried and milled into flour it can be easily used in bakery products as a rich source of functional ingredients. Finding other possible applications for BSG, especially in bread and pastry production, can lead to the minimization of environmental impact, can be beneficial for businesses as a cheap or no-cost material and can have improved value for consumers.

Keywords: brewer's spent grain, raw material, bread, functional food

AUTHOR INDEX

AUTHOR INDEX

A

Abdellaoui, Zakia, 79
Abičić, Ivan, 52
Ačkar, Đurđica, 23, 45, 46, 60, 65
Ačko, Metka, 16
Adanić Pajić, Andrea, 91
Afonso, Ana, 6
Aktas-Akyildiz, Eda, 24
Alibašić, Hurija, 29, 35, 36
Antolić, Ana, 44
Arıbaş, Merve, 55
Avdić, Gordan, 29, 35, 36

B

Babič, Janja, 17
Babić, Jurislav, 23, 33, 45, 60, 65
Bačić, Valentina, 105
Banožić, Marija, 37
Banjac, Vojislav, 17
Barron, Andrew R., 90
Barrucci, Federica, 6
Bartkevics, Vadims, 11, 18, 57, 61
Bartkiene, Elena, 11, 18, 57, 61
Batinić Sermek, Marija, 13
Birkić, Draženka, 70
Blažić, Marijana, 56, 70
Bogdanović, Tanja, 12
Boglárka Zakupszki, Zita, 78
Borišev, Ivana, 3
Bosiljkov, Tomislav, 71
Bucić-Kojić, Ana, 43, 75
Budimir, Valentina, 62
Budžaki, Sandra, 30
Buratović, Andrea, 47
Byelyayeva, Inna, 95

C

Cikoš, Ana-Marija, 37
Crevar, Biljana, 102
Cvetković, Tanja, 45

Č

Čačić Kenjerić, Daniela, 89
Čolović, Radmilo, 17
Čukelj Mustač, Nikolina, 44, 47, 62

Ć

Ćurić, Duška, 44, 47, 62

D

De Sanctis, Giacomo, 6
Demirtasoglu, Zeki, 26
Diósi, Gerda, 98
Djordjevic, Aleksandar, 3
Djukić, Nevena, 84, 96
Dodig, Dejan, 20, 85
Domig, Konrad, 57
Dorbić, Boris, 64
Dorne, Jean Lou, 6
Drakula, Saša, 47, 62
Drezner, Georg, 4, 33
Dubat, Arnaud, 27
Dubinina, Antonina, 95
Dugalić, Krunoslav, 51
Dukić, Branimir, 25
Dukić, Stojanka, 25
Dvojković, Krešimir, 4, 68
Dziendzikowska, Katarzyna, 97

Dž

Džafić, Amela, 77

Đ

Đugum, Jelena, 13

F

Filipčev, Bojana, 63
Fišteš, Aleksandar, 46
Friganović, Emilija, 64

G

Genç, Tülay Kahraman, 99
Gökmen, Vural, 20
Grec, Marijana, 60
Grgić, Ivanka, 60
Grgić, Josipa, 43
Grilec, Ivona, 105
Gromadzka-Ostrowska, Joanna, 97
Gross-Bošković, Andrea, 14
Grubišić, Sanja, 103
Gryszkin, Artur, 65
Gürsul, Işıl, 20
Győri, Zoltán, 66, 76

H

Habuš, Matea, 44, 47
Hagh Nazari, Simin, 84, 96
Halmi, Lahorka, 56
Harasym, Joanna, 31, 67, 73, 74, 97, 100, 101
Hershun, Valeriia, 95
Hofmanová, Taťána, 58
Horvat, Daniela, 4, 33, 68, 75
Horváth, Brigitta, 76
Hruškar, Mirjana, 62
Hrušková, Marie, 58
Hublić, Jasmina, 29, 36

I

Ištuk, Jozo, 92
Ivanuša, Mario, 69
Ivić, Ivana, 32
Ivić, Marko, 4, 68

J

Jakobek, Lidija, 90, 92
Jakovac Strajn, Breda, 17
Janić Hajnal, Elizabet, 17
Jašić, Amela, 35
Jevcsák, Szintia, 98
Jokić, Stela, 37
Jovanović, Kristina, 30
Jović, Danica, 3
Jozinović, Antun, 23, 33, 45, 46, 60, 65
Jukić, Goran, 51
Jukić, Katarina, 43
Juodeikiene, Grazina, 11, 18, 61

K

Kaim, Urszula, 31, 67, 73, 74, 100, 101
Kapačinskaitė, Rasa, 58
Kapelko-Żeberska, Małgorzata, 65
Kerovec, Darko, 52
Knežević, Nada, 69
Koceva Komlenić, Daliborka, 83
Kojić, Nebojša, 60
Köksel, Hamit, 5, 24, 55
Kolarić Kravar, Sanja, 13
Konsta, Angeliki, 6
Kopjar, Mirela, 32, 72
Kos, Jovana, 17
Kovač, Tihomir, 102
Kovačević Babić, Marija, 33, 75
Kralj, Elizabeta, 70
Kristić, Marija, 103
Krpan, Marina, 62

L

Lalić, Alojzije, 33, 52, 75
Lefkir, Samia, 79
Leko, Jozo, 30
Leko, Tomislav, 30
Lele, Vita, 11, 18, 57, 61
Lenert, Svitlana, 95
Lisjak, Miroslav, 103
Listeš, Eddy, 12
Liška, Matea, 32
Lončarević, Ivana, 46
Lončarić, Ante, 65, 102
Lončarić, Zdenko, 52, 103

M

Maggiore, Angelo, 6
Maksimović, Vuk, 85
Marić, Maja, 32
Marijanović, Zvonimir, 64
Marković, Ksenija, 19
Marković, Stefan, 84, 96
Masatcioglu, M. Tugrul, 5, 24
Mastilović, Jasna, 83
Matas, Raquel Garcia, 6
Matijević, Bojan, 34
Mavar, Mladen, 104
Mayrhofer, Sigrid, 57
Miličević, Borislav, 23
Miličević, Dijana, 29, 35, 36
Mitrović, Saša, 25
Molnar, Dunja, 71

N

Nakov, Gjore, 75
Nedić Tiban, Nela, 45, 72
Nezić, Emina, 29, 36
Novoselović, Dario, 4, 68
Novotni, Dubravka, 44, 47, 62, 71, 93

O

Orkusz, Agnieszka, 31, 67, 73, 74, 100, 101
Oros, Damir, 105
Oršolić, Ivan, 43
Oručević Žuljević, Sanja, 53, 77
Ounane, Ghania, 79

P

Pajin, Biljana, 41, 46
Palfi, Marina, 69
Panak Balentić, Jelena, 60
Panjkota Krbavčić, Ines, 19, 105
Pavlić, Martina, 94
Pavšič Vrtač, Katarina, 17
Petričević, Sandra, 12
Petrović, Jovana, 46
Petrović, Sonja, 103
Pichler, Anita, 32
Planinić, Mirela, 43
Plavšin, Ivana, 4, 68
Pleadin, Jelka, 7
Pollak, Lea, 91
Popova, Tetiana, 95
Predrijevac, Krešimir, 30
Pugajeva, Iveta, 11, 18, 57, 61

R

Ranilović, Jasmina, 45
Rebekić, Andrijana, 52, 103
Reitter, Michael, 59
Rujevčan, Davorka, 70
Rukavina, Ivana, 51
Rumbak, Ivana, 104
Rumora Samarin, Ivana, 19, 105
Rumpl Tunjić, Slađana, 15

S

Sakiene, Vytaute, 11, 61
Samodol, Ana, 105
Saric, Goran, 106
Sąsiadek, Wojciech, 74
Selaković, Anastasija, 63
Semić, Amela, 77
Severović, Kornelija, 56
Simić, Marijana, 85
Sipos, Péter, 76, 98
Skelin Paulić, Iva, 42
Sokolić, Darja, 12, 54
Solińska, Dominika, 65
Sorić, Tamara, 104
Stanković, Anamarija, 37
Starčević, Antonio, 105
Sviličić, Petra, 8
Szabó, Balázs P., 78

Š

Šafranko, Silvija, 37
Šarkanj, Bojan, 102

Šarolić, Mladenka, 64
Šatalić, Zvonimir, 19
Ščetar, Mario, 71
Šelo, Gordana, 43
Šereš, Zita, 63
Šimić, Gordana, 33, 52, 68, 75
Šimurina, Olivera, 63
Šišić, Gabrijela, 44
Šoronja-Simović, Dragana, 63
Šubarić, Drago, 23, 45, 60
Šunjić, Krešimir, 51
Šušak, Ana, 43, 75
Švec, Ivan, 58

T

Tanović, Martina, 29, 35, 36
Tašner, Lidija, 16
TIM ZIP Ltd, 28
Tišlarić, Zrinka, 19
Tišma, Marina, 43, 75
Tomas, Srećko, 43
Torbica, Aleksandra, 83, 84, 96

V

Vađunec Bajrić, Irena, 45
Vahčić, Nada, 19
Van der Stede, Yves, 6
Varešić, Branka, 77
Varnica, Ivan, 51
Véha, Antal, 78
Viszmeg, Jožef, 30
Vizbickiene, Donata, 18
Voučko, Bojana, 44, 47, 62
Vučetić, Višnjica, 8

Y

Yesli, Abdenour, 79

Z

Zadeike, Daiva, 11, 18, 61
Zahorec, Jana, 63
Zarić, Danica, 46
Zavistanaviciute, Paulina, 11, 18, 61
Zeynep Arslan, Esra, 26
Zięba, Tomasz, 65
Zokaityte, Egle, 61
Żyła, Ewa, 97

Ž

Žilić, Slađana, 20, 85
Živančev, Dragan, 83, 84, 96
Živić, Ana, 72
Žučko, Jurica, 105

SPONSORS AND EXHIBITORS

SPONSORS

GOLDEN

BASTAK instruments

timzip nutrition-technologies-development

BRONZE

Ru-Ve

Labena

ALPHACHROM science with confidence

actor

OTHER

MEDIA SUPPORT

biscuit people

Fırıncılık Bakery | Bisküvi Biscuit | Makarna Pasta
Fırıncılık, Bisküvi ve Makarna Sektörü İhtisas Dergisi
Bakery, Biscuits and Pasta Sector Specialty Magazine

Pekarski Glasnik
portal za mlinare, pekare i slastičare

EXHIBITORS

BASTAK instruments

timzip nutrition-technologies-development

Labena

ALPHACHROM science with confidence

Ru-Ve

Brabender … where quality is measured.

PFEUFFER

actor

FRIGOR TEC Cooling to the point

KEFO SINCE 1949

KemoLab d.o.o.

Ansar-analitika d.o.o. Analytical equipment

CHOPIN TECHNOLOGIES

www.mobula.eu MOBULA d.o.o.

OPSIS LIQUIDLINE

Unity Scientific

cras

WINTERSTEIGER Thinking about tomorrow.

GOLDEN SPONSOR

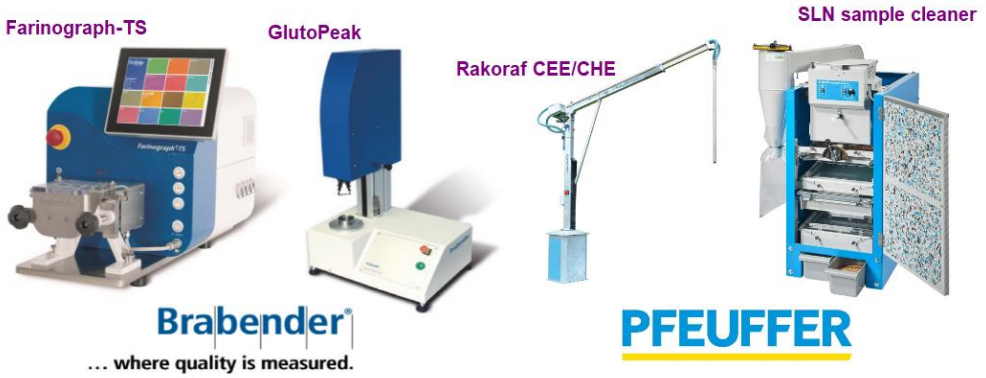
GOLDEN SPONSOR

COMPREHENSIVE OFFER

- Turn-key projects
- Machines and equipment
- Production lines
- Raw materials
- Technological support
- Installation and service

timzip
nutrition - technologies - development

BRONZE SPONSOR



Tvrtka Ru-Ve službeni je zastupnik proizvođača laboratorijske opreme Brabender i Pfeuffer!

Brabender i Pfeuffer dvije su vodeće tvrtke za razvoj, proizvodnju i distribuciju instrumenata i opreme za ispitivanje kvalitete i fizičkih svojstava materijala u kemijskoj i prehrambenoj industriji. Iz proizvodnog plana tvrtke Brabender izdvajamo uređaje Farinograph-TS i GlutoPeak. Farinograph-TS pruža pouzdanu sliku svojstava upijanja vode i miješanja brašna. GlutoPeak je brz, automatiziran i pouzdan uređaj za mjerenje glutena u žitaricama. Također izdvajamo i uzorkivač Rakoraf CEE/CHE te pročišćivač SLN sample cleaner renomirane tvrtke Pfeuffer. Rakoraf CEE/CHE je robustan, čvrst i pouzdan uzorkivač idealan za uzorkovanje izravno iz teretnih vozila. Uzorke je moguće transportirati izravno u laboratorij. SLN sample cleaner osigurava pročišćavanje uzoraka kroz sita raspoređena na više razina. Sva uklonjena nečistoća zaprema se u vrećicu na dnu uređaja te u posudama ostaje čist uzorak spreman za laboratorijske analize. Za sve detalje i upite vezane za ostale Brabender i Pfeuffer uređaje kontaktirajte nas putem e-mail adrese: info@ru-ve.hr ili telefonskog broja: 01/335-250.

Ru-Ve

info@ru-ve.hr t:+385(0)1-33352-50 f:+385(0)1-33352-59
Vladimira Nazora 10 – Brezje, HR-10431 Sveta Nedelja

BRONZE SPONSOR

BRONZE SPONSOR

BRONZE SPONSOR

actor

FRIGOR TEC
Cooling to the point

www.actor.si